ENGINEERING NEWS.

BY advices from New South Wales to January 24, we learn that work is progressing very favorably on the foundations of the Hawkesbury Bridge, considering the extreme difficulty of the conditions. One caisson was down 50 ft. in the ground, with 90 ft. of connected iron-work, the water being about 25 ft. deep. The second caisson was well under way. The material for the whole six caissons had arrived in port from England.

THE pneumatic foundation for Pier No. 2, of the Harlem river bridge is down 33½ ft. below mean low tide, with about one-half of its area covering solid rock; the final bottom will be probably reached within the next 10 ft. The concrete foundation of Pier No. 1, is in place, and the first course of masonry about laid. The removal of the rock in the pneumatic caisson is done by a Rand No. 3 drill and charges of dynamite; three to four holes are fired at one time, with as much as 1½ cartridges in each hole, without any damage to the structure or inconvenience to the men.

Mr. W. H. ATWOOD, Div. Engineer Colorado Midland Railroad, writes us that the following should be included among our "fast tunneling" records as lately published. In last November, at Tunnel No. 5, of the above road, near Manitou Springs, Col., a heading progress of 98¼ ft. was made in twelve consecutive working shifts of ten hours each. The heading was 8x16 ft. and the material was a solid, coarse-grained granite. The drilling plant was of the Ingersoll type. No expense was spared in handling the muck.

IT is stated "from trustworthy sources" that three great railroad building firms have taken the contract for a 700-mile extension of the St. Paul, Minneapolis, Manitoba Railroad, between Mouse river, in Northern Dakota, and Great Falls in Montana, on rather extraordinary terms. The construction is to be pushed as few lines ever have been; 50,000 men, if they can be had, are to be put on as soon as the Spring opens. It is claimed that the line will be in operation before next Fall from St. Paul to Helena, and will have branches to Butte and all leading Montana points, competing with the Northern Pacific.

Beyond Helena the line is known as the Montana Central. This seems a rather rapid proposition, but it is not much more so than the proposed extension of the Atchison, Topeka & Santa Fé to Chicago, nearly 500 miles, which is to be completed this season. But that is with all the advantage of surrounding civilization.

M. LESSEPS has come out with a new declaration on the canal question to the effect that

> he "had learned with pleasure of the formation of the Nicaragua Co., which would improve the prospects of the Panama Canal Co. The Nicaragua enterprise, being a fresh water canal, *would be useful as a means of irrigating and fertilizing the country.* M. DE LESSEPS scouted the idea that the Nicaragua enterprise that could be used for inter-oceanic traffic, as, owing to endless locks increasing the time of transit, *vessels would prefer going round Cape Horn.* Referring to the Panama Canal, he said the only point of anxiety was the rocky Culebra, although he was firmly convinced that the contract would be finished within the specified time. The work would soon be pushed day and night, lighting the Culebra by means of electric lights. The Directors of the company anticipate that the work accomplished in 1887 will be double that done in 1886."

If "according to your faith be it unto you" will only hold good in M. LESSEPS' case he should be able to finish his canal much "within the specified time." To the outside skeptic, who knows that not even the first step has as yet been taken toward the most serious problem and costly work of all, controlling the Chagres river, and that the surface has been hardly more than scratched on the canal proper, its most solid chance of completion within our generation seems to be by the power of faith. And M. LESSEPS faith must be weakening a little, or he would not admit that the Nicaragua Canal would be useful even for irrigation.

In the mean time the Nicaragua company has been organized under the bill which has just passed, with some appearance of probable strength, and we trust they may prosper enough to test the lock question practically. It is difficult to see any definite grounds for the antipathy which many other less prejudiced persons than M. LESSEPS, have for the use of locks. With modern hydraulic machinery there would not be, or rather, we should say there has not been found to be, any difficulty in handling the heaviest ships through locks in 15 to 20 minutes. An interesting discussion on this question before the American Society of Civil Engineers in 1879-80, brought out this fact very clearly. But allowing that an average of two hours per lock was required; to make the lift of 103 ft. at Nicaragua, and down again to sea level, if done with say 15 locks, would only involve the loss of say 30 hours time, which is a very small addition to the total length of the voyage, and makes M. LESSEPS declaration, that vessels would prefer to go round the Horn rather than lose it, rather ridiculous. It is not to save hours, nor even days, but to save weeks and months, that an inter-oceanic canal is desirable.

Capt. EADS' ship railway bill has also passed the Senate, and as Capt. EADS is only less energetic than M. LESSEPS, it may yet prove that he will carry through the first inter-oceanic communication project. Engineers ought certainly to hope that he will do so, as nothing of greater engineering interest and novelty has been proposed in our generation. That it can be successfully completed and used, with perhaps greater advantage than any canal, there seems no reason to doubt, and there would be a certain advantage in the transportation of ships over land that it would save dockage. The government does no more for either of these projects than to incorporate them, and stipulate that the charters shall be forfeited if work is not begun within two years. We can only say of them, like the vagabond in the "Beggar's Opera,"

> "How happy could I be with either
> Were t'other dear charmer away."

and wish them both success, and M. LESSEPS likewise.

ACCORDING to *Le Canal de Corinthe*, of February 15, work is there progressing at an average of 6,000 cu. metres per day of material removed. The Chief Engineer states that in his opinion the work will be finished in the present year and at a cost within the estimates. But it is also now certain that supplementary works will be necessary; these will include the lining of the sides of the canal with masonry to a height of about 33 ft. and for a distance of about 14,000 ft. And the formation of a bench about 6½ ft. wide on each side of the canal, and about 6 ft. above sea-level. And finally a decrease in the slope of some parts of the cutting to insure stability in the sides.

THE bills for building our new navy are having a hard time of it between the two branches of our national government. But if the Senate now consents to the modified House bills we will have in all about twenty-five new ships costing less than $25,000,000, as a result of the sessions of 1885-86. As England has expended in the last sixteen years about $150,000,000 for new war-ships; France, $89,000,000, and Italy, $28,000,000, we do not see that we can be called extravagant as yet. We would advise more ships, some heavy guns and better protection to our sea-coast, and less pension money. Pension agents are the parties who would suffer most by any change in the present methods of distributing our surplus revenue.

THE interest in the car-heating question shows no signs of dying out, and the indications multiply that the series of unusually great disasters this winter, will bear permanent fruit in a change of our system. The explosion of one of the water-heaters, with the subsequent burning of the car and narrow escape of the passengers has again emphasized the need of some better system, as has also the verdict in the Republic disaster. Hearings have been held in several states and much legislation is proposed, including some very wise recommendations by the Vermont commission, elsewhere noted, which it is more than likely will be copied by other States, based on the recommendations of this journal. The only sensible form of legislation as to the heating question, however, is to stipulate that after a period of not less than three years, and perhaps longer, it shall be unlawful to run cars heated by fire carried on them. There would be no real difficulty in living up to such a law, but time is still necessary to enable roads to experiment somewhat before acting finally, if they are to act intelligently.

TECHNICAL NOTES.

THE newest forms of the Strong boiler and locomotive differ materally from forms heretofore in use, and seem to be making an excellent record. The boiler is the most interesting feature and the most radical departure from the usual form, and in principle it certainly seems meritorious. It has double fire-boxes, intended to be fired in succession, which unite in a single combustion chamber as the legs of a pair of pantaloons unite with the top part, but in this case the top part is of the same size as the legs. This whole interior part of the boiler is formed of three welded and corrugated steel cylinders connected by a similarly welded and corrugated steel junction piece. These parts are connected together by rivets through external flanges, and as the cylinders are stiff enough to resist the collapsing pressure by their own strength, not a single rivet or stay-bolt is exposed to the fire. The corrugations also permit the interior parts to expand and contract without throwing injurious strains on the outside shell of the boiler.

The valves and valve motion are also of quite novel design and its future performance will be watched with much interest.

SOMETHING like 300,000 of the Bush interlocking bolts are now in use, chiefly in yards and at bridges and as a substitute for rail-braces on curves. The yard of the Grand Central station is almost entirely laid with them, largely in combination with a cast-iron pot tie. The auger guide for boring the holes, which it has been sometimes feared might cause derailment is made so as to be readily breakable by any considerable force in such way that none of the pieces can fial so as to cause derailment.

AN ingenious kind of packing gland for submarine work, which may serve as a hint for other requirements, has been devised by Mr. H. H. HALL in operating his tunneling caisson, an illustration of which may be referred to in our advertising columns to make this description clear. He had at first an ordinary stuffing box gland, 18 in. long, through which his pipe projected from his caisson, but it interfered more or less with the working of the caisson, especially when it was desired to change its direction from straight ahead. He, therefore, placed some ordinary rubber hose, about four turns of it, between his caisson and pipe, so that it was slightly compressed. By pumping in water under a slightly greater pressure than that due to the head of water over the caisson a perfectly water-tight joint was secured, and at the same time one that was perfectly flexible and almost without friction.

To calculate the section of hoisting cables to adapt them to a given load and allowing for their own weight, the following rule is given by the *Compagnié des Forges de Châtillon:* Let P be the weight to be raised; L, the length of the cable; R, the resistance to rupture in "kilogrammes per square millimetre," and $\frac{1}{m}$ the coefficient of safety adopted, which may be taken at ⅛, but is sometimes taken at $\frac{1}{10}$. Then if we adopt a cable of useful section S, and useful weight per metre p, we have $p = S\ 0.0085$. But as the cable should also carry its own weight, we have $\frac{R\,S}{m} = P + L\,p$; whence $\frac{R\,S}{m} = P + L\,S\,0.0085$; whence $p = 0.0085\,S = 0.0085\,\frac{P\,m}{R - L\,m\,0.0085}$.

THE Senate, by an amendment to the House bill to create a Department of Agriculture and Labor, has transferred the "weather service" of the Signal Service Bureau to this new department. In the words of Senator MORGAN, all that would then be left of the Army Signal Service would be "a Brigadier General and sixteen Lieutenants." Rather a top-heavy outfit.

et Grade Intersections.

A. CALKINS, M. AM. SOC. C. E.

(*Concluded from page 135.*)

The plan given in Fig. 7, is a portion of the Central Park, with Ninth avenue on westerly side, and Eighth avenue on the easterly, the latter separating it from the main portion of the Park. The grades of Ninth avenue from 77th to 81st street have a rise of 3 in. only between each street, too light for surface drainage. Eighth avenue has a level grade from 69th to 80th street, both therefore required special treatment, and to provide this, the writer prepared the grades shown in Fig. 8 and 9.

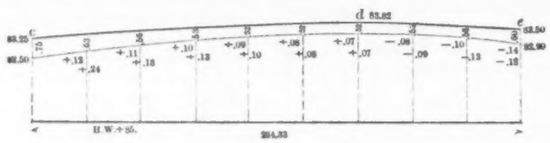

Fig. 8.

In Fig. 8 the curved line represents grade of curb, lighter parallel line grade of gutter, and numbers between the two depth of gutter. The distance between centers of streets is divided into nine equal parts, the crown in grade at d being placed one-third this distance from highest established grade.

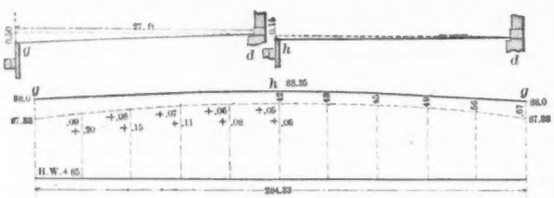

Fig. 9.

The first row of numbers below gutter line are factors to be added, at each station to grade at c, or subtracted from grade at d. Lower row of factors are for gutter.

The curb grade increases 0.57 in six stations in a distance of 189 ft., and falls 0.32 in three stations or in 94 ft.; but the grade of gutter increased 0.80 in six stations, and diminishes 0.40 in three stations.

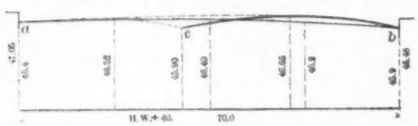

Fig. 10.

Receiving basins are located at center of each street as shown on plan in Fig. 7.

In Fig. 9, the crown is made at center of block; the grade of Eighth avenue being level, a different adjustment of grades became necessary. The entire length is divided into ten equal parts, the factors having equivalent values on either side of the crown. The numbers between the lines showing depth of gutter, and first row of number below dotted line factors to be added to grade at c, and c, to produce grade at e. The second row of factors are to be added to gutter grades at e and c. The sections over profile indicate the effect this grade has on the side-walk; d, representing park wall, and g, h, the curb. The section g, d, is taken at lowest point in the grade, making slope of walk 0.50 in 27 ft. Section h, d, is taken at the crown of the curb which has a slope of 0.15 in 27 ft. The grade of gutter falls 0.58 n 142 and grade of curb 0.33 in the same distance.

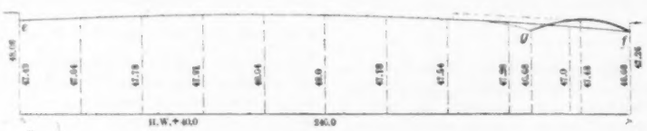

Fig. 11.

The adjustment of the gutter in Fig. 8 and 9, for the purpose of removing storm water, is deemed ample for that purpose.

The light slope in the walk at h, d, is objectionable, but the additional fall in grade from it in the direction of g the lowest point, will remove any surplus from that portion of the walk if the surface of walk is kept in good condition.

The plaza at the Fifth avenue entrance of the Central Park is shown in Fig. 12, and is located between 58 and 59th street, extending westerly of the west curb of Fifth avenue 255 ft.; but practically the line extends to easterly curb of Fifth avenue as no curb has been set on the dividing line, making entire width of roadway 246 ft.

In 1884 the pavement on plaza being out of repair, and railroad tracks in 59th street very low they were often flooded during heavy storms; the writer was then directed to prepare a new grade, new only in its detail, the controlling points conforming to the established grades. A careful examination soon indicated that a grade which would facilitate public travel at this point, should be continuous, crossing the roadway of Fifth avenue without a break, which would be the case if the usual crown of pavement on Fifth avenue were continued through it, producing a gutter from 58th to 60th street, indicated by a broken line. A section of this gutter line is shown in Figs. 10 and 11 at e and g.

The main line of carriage travel is represented in Fig. 12 by a broken curved line extending up Fifth avenue at h, and into the park at i; a similar line is given also, beginning at j, in 58th street, crossing plaza, and continued up Fifth avenue, but this is used principally for traffic. More carriage travel is concentrated here, passing over the route indicated, than can be seen at any other point in this city, and very probably in the United States.

Assuming that a continuous grade line would promote carriage travel better than a broken one, the entire width was divided into ten equal parts, and the length southerly from south curb of 59th street into eight parts. The crown is indicated by a line drawn under the grades given on plan Fig. 12. This crown is near center line of travel at 59th street, but diverted westerly from this center in the direction of 58th street, as the grades of adjacent curb would not permit a crown to be made southerly through the center line. The grades northerly of the railroad tracks were arranged in harmony with this plan.

The dots indicate grade stations, and numbers near them, the grades. The portion of the pavement repaired at this time extended from 58th to 59th street and easterly to west curb-line of Fifth avenue. The roadway of this avenue being under the control of the Department of Public Works, no repairs were made at this time. A foundation for the pavement was prepared with Telford where required, on which McAdam stone was spread to bring it up to the required sub-grade, the surface being finished with gravel, all of which was thoroughly rolled. Figs. 10 and 11 are sections of this continuous grade line, extending from a to b in the former, and e to f in the latter, which corresponds with elevations given in Fig. 12. This grade may appear very flat, but two years of traffic and carriage travel concentrated at this point has demonstrated the crown to be ample for removing all surface water, if care is taken to keep it in good condition. When the new granite pavement was recently laid on Fifth avenue at this point, no use was made of this continuous grade line, but the usual section of Fifth avenue pavement, as shown on profiles Fig. 10 and 11, by a heavy black line at c, b and g, f was adopted; with a crown of 9 in. the center projecting 3 in. above grade of curb.

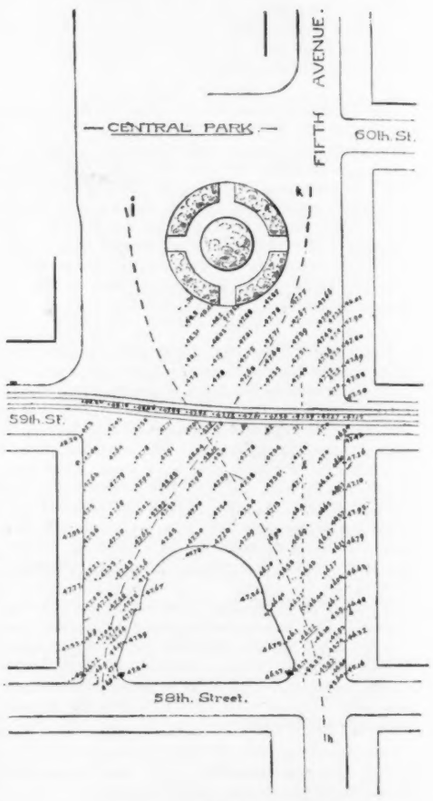

Fig. 12.

This section of the pavement formed a gutter from 58th to 59th street as indicated at e and g, making a union necessary with former pavement laid on the Plaza, shown by lower dotted line on profiles. This gutter after having been found objectionable, on account of the gutter line crossing the main line of carriage travel, and constant accumulation of mud obstructing flow of storm water, the pavement was taken up to the crown and relaid to a new grade making this crown the initial point. In making this change the width of the granite pavement was increased also by extending it to the westerly building line of Fifth avenue, as represented by upper dotted line on profiles. This made a change necessary in the grade of pavement of Plaza to connect with this new grade, and also will increase the depression at crossing of the railroad tracks (on center line of travel), which this company raised in 1884 to avoid. When the grades of this Plaza were arranged in 1884, the object kept in view by the writer was to adjust the grade lines in such a manner, that in whatever position it was observed a perfect union of the grade lines could be seen, and also give a crown that would remove all storm water.

GILLESPIE in his "Manual of Roads" recommends a cross-section of a paved street to be 1 in 40 or 50: and Gillmore in his recent work on "Roads and Street Pavements" a section of 1 in 40. Had the latter

been adopted the crown of the pavement on Fifth avenue would have been six inches instead of nine.

When a pavement becomes slippery, caused by a coating of mud or ice, a condition any pavement in this climate is liable to be in during the winter season, a crown of six in. would be far more agreeable and safe for carriage horses or for traffic. A high crown will contract the width of a roadway when slippery, by concentrating travel at the crown while a low crown will permit the whole width of a paved roadway to be utilized.

Schuylkill River East Side Railroad.

BY H. T. DOUGLAS, CHF. ENG. PHILA. BR. B. & O. R. R. AND S. R. E. S. R. R.

The ordinance granting the right to build this road, which is the connecting link between the Baltimore & Philadelphia Railroad, and the Philadelphia & Reading Railroad, and which extends from the crossing of the Chester branch of the Reading Railroad, on the west bank of the Schuylkill river to Poplar street and Pennsylvania avenue, a distance of 3⅝ miles, with a branch line extending from a point on the main line on the east bank of the Schuylkill river along Schuylkill avenue to Wolf street, thence along Wolf street to 23rd street, thence along 23rd street to Oregon avenue, thence along Oregon avenue to Meadow street and along Meadow street to Reed street on the Delaware river, a distance of 5⅝ miles, was passed by the City Councils of Philadelphia after a hard fight, and approved by the mayor in July, 1885.

Work was begun as soon thereafter as settlements for the rights of way could be perfected.

The contracts for the foundations and masonry for the Schuylkill River bridge were let in the latter part of July, 1885. To Gen. WM. SOOY SMITH, was assigned the contract for the substructure, including the pneumatic caissons, and to Messrs. DRAKE & STRATTON the masonry.

In building the piers four caissons were used, which were sunk to rock reached at depths varying from 47 ft. to 73 ft. below low water. No special difficulties were encountered in sinking the caissons, the material overlaying the rock was generally hard mud, with small interlying seams of sand, all of which was easily removed by sand pumps. The rock was irregular and of a micaceous nature, the top being soft, which was removed, the rock levelled off, the working chambers and coffer dams over caissons filled with concrete and rubble, and the masonry begun. The rubble and concrete in the coffer dams over the caissons was taken up to a point 10 ft. below low water, at which point the masonry begins.

The first stone of the masonry proper was laid in October, 1885, the whole work including substructure and masonry was completed in March, 1886. This work consisted of two ⊤ abutments, three piers, one pivot or draw pier, and two guard or rest piers.

The guard piers were built on piles, driven and cut off 12 ft. below low water, then a grillage of 12x12, timbers doubled was framed and fastened to the Piles, and the masonry built on the grillage. The foundations to one of the piers located in water 12 ft. in depth was put in by the use of an open wrought-iron cylinder, 66 ft. in diameter, lined on the inside with 12x12, pine staves, J. E. ROBINSON, patentee.

The whole work was pushed with great energy and completed without serious accident or delay, reflecting great credit upon the contractors and engineers in charge.*

The superstructure of the Schuylkill bridge, consisting of two spans of 200 ft. each, one span of 150 ft. and the draw span of 243 ft., was built by the Keystone bridge company. The draw is a pivot draw with two openings, one on either side of the draw pier, and is worked by steam. The bridge is for a double track road, and is a substantial and handsome structure.

The main line of the Schuylkill river East Side Railroad, crosses the Schuylkill river about 1,800 ft. below, or southeast of the Grays Ferry Bridge and then continues in a northeasterly course, passing under Wharton street, and by tunnel 400 ft. in length under the Grays Ferry Road, and the P. W. & B. Railroad near the intersection of 34th street with the Grays Ferry Road, reaching the east bank of the Schuylkill river for the second time near the Kalicon works at the intersection of Schuylkill avenue with 31st street. The line then follows the east bank of the Schuylkill river, passing through the grounds of the United States Arsenal, United States Naval Asylum, the City Gas works located between 23rd street and the Schuylkill river, and between Chestnut and Filbert streets, and the old Gas works of the city, located at 25th and Callowhill streets, and passing under the Pennsylvania Railroad bridges between Peltz and Christian streets, and at Filbert street under the city bridges on South, Chestnut, and Market streets, and goes into tunnel at the intersection of 25th and Callowhill streets, thence along 25th street, under cover to the intersection of Fairmount avenue with Pennsylvania avenue, and thence along the northwest side of Pennsylvania avenue to an intersection with the Reading Railroad at Poplar street, near the point at which Girard avenue crosses Pennsylvania avenue into Fairmount Park. See Fig. 1.

From 25th street to Taney street, a distance of 2,303 ft., the road is constructed under the streets for a distance of 728 ft., sidewalls were built, over which girders were laid and over the girders buckle plates of steel galvanized.

The steel buckle plate was used because it presented a surface freer from defects than iron, and the effect of galvanizing was to protect the surface from the action of steam and gases from locomotives.

On the buckle plates was laid 2 in. of asphaltum pavement, then 6 in. of sand, and then the paving block. Fig. 2 will show the form of construction.

For a distance of 1,575 ft. a brick arch with sidewalls of stone, as shown in Fig. 3, has been used. The cutting for this work was principally through rock, some of it of a soft and rotten nature and other very hard, varying from 12 to 35 ft. in depth. An open cutting was first made, the masonry then laid and filled over and the street grades restored. Northwest of Taney or 27th street and Penna. avenue, for a distance of 1,865 ft., the line is in open cutting with retaining walls on both sides, on the northeast side, runs the main line of the Reading Railroad on the northwest side is located Fairmount Park.

The difficulties encountered in the construction

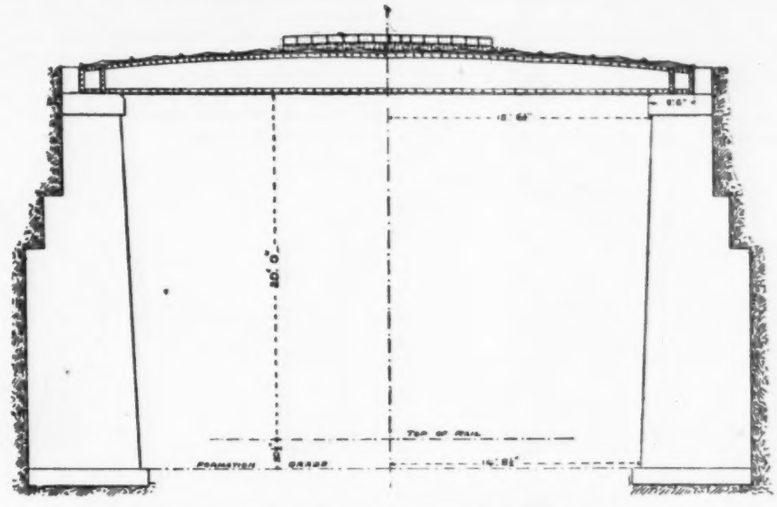

Fig. 2.—Open Tunnel Section; S. R. E. S. R. R.

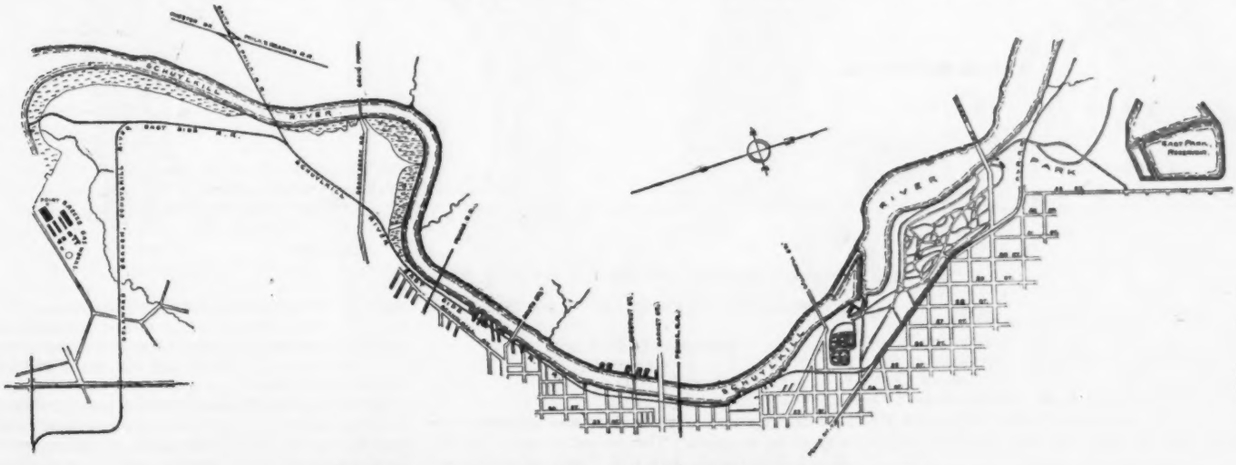

Fig 1.—Map showing location of Schuylkill River East Side R. R.

*For the details of these foundations, see ENGINEERING NEWS, pp. 85 and 195. Vol. XV.

of the line from 25th and Callowhill streets to 30th street and Penna. avenue were those to be expected in constructing a line under the streets of an old and populous city, and were very great, consisting of water mains ranging from 20 to 48 inches in diameter, gas mains, sewers from 3 to 10 ft, which were met with at many points and had to be provided for; large buildings were raised, some of them as much as 11 ft. to the new grade of the streets; the gas and water connections with dwellings and large manufactories cut and restored. Five lines of street car tracks had to be changed and kept open; the traffic of streets to be maintained; the drives into the Park kept open; the traffic of the Reading Railroad, alongside of which we were building and which was constantly threatened, cared for, and the dangers to large buildings alongside of which we were blasting rock and building masonry within a few feet of their foundations and as much as 20 ft. below them, protected. The work was accomplished with as few accidents as were possible, and with but little delay.

The contractors for the work were as follows:—

From the Chester Branch of the Reading Railroad to Chestnut street, excepting the Schuylkill Bridge, Messrs. Ryan & McDonald; from Chestnut street to Fairmount avenue, Messrs. Drake & Stratton; from Fairmount avenue to 30th street and Pennsylvania avenue, Mr. James J. Ryan; for the Iron and Steel work (covered way), The Edge Moor Iron Co., through Mr. Fredk. H. Smith. The work was pushed night and day. The heavy section from 25th and Callowhill streets, to 30th and Poplar streets, was begun in January, 1886, and completed December 2, 1886. Trains passing through the tunnel and over the entire line on that date.

The main line of this road presents the rather remarkable feature of passing through the City of Philadelphia for a distance of 3⅝ miles, without crossing at grade a single street in use for travel except one, and that at the point the connection is made with the Reading Railroad.

The Passenger station is located at 24th and Chestnut streets, extending from Walnut to Chestnut streets, the main entrance being on a level with the grade of Chestnut street. This building will be one of the largest and handsomest in the country.

From the branch line which has been before described, connections are made by barge lines from Dickinson street pier to points along the Delaware river front, in the heart of the business centres, cars are transported on barges to piers located at the most accessible points to accommodate the great traffic of the city of Philadelphia.

A map of the main line and a portion of the Delaware branch is hereto attached. The construction of the entire line was accomplished within sixteen months; the difficult work in about eleven months from the date begun. But few delays occurred and those such as were occasioned by the necessary preparations for the work under the streets, and in settlement of rights of way.

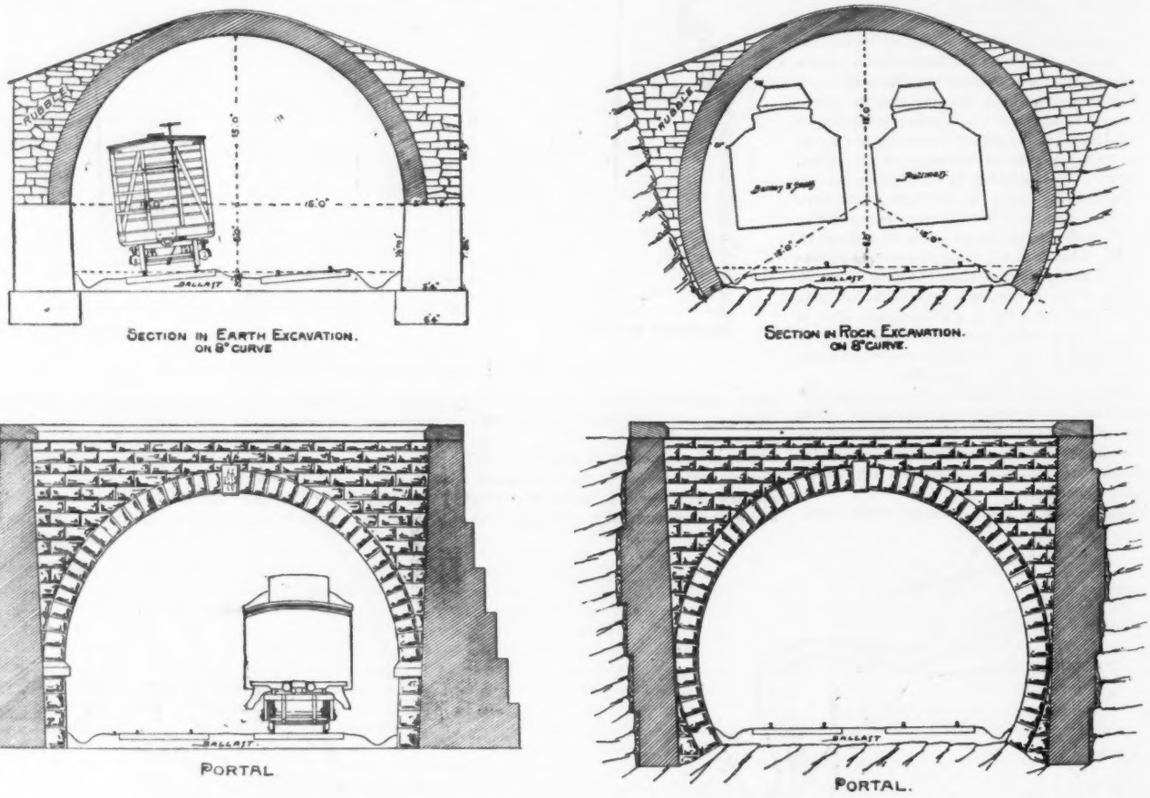

Fig .3.—Tunnel Sections; Schuylkill River East Side R. R.

Municipal Engineering; Paper No. 4.*

PHILADELPHIA, PA.

(*Concluded from page* 136.)

Contracts.

Nearly all city work is done and materials furnished by contract. The laying of pipe by the Water Department and Gas Trust, however, and some smaller work is done by days' labor.

Advertisement must be made three times in two daily papers—the first advertisement at least ten days before the opening of proposals.

Bids of over $500 must be accompanied by a certificate of the City Solicitor, that security in the sum of $500 has been entered at his office.

Proposals are opened in the presence of the head of the Department and of at least three members of the proper Committee of Councils, and the contract awarded to the lowest responsible bidder.

No contracts can be made by heads of Departments for work or materials not authorized by Councils.

Contracting parties must be skilled and regularly engaged as to their proper occupation, trade or business, and must personally superintend the work. No sub-letting is allowed.

Contractors are required to enter security in city real estate to one-half the amount of their contract or (at their option) to deposit 25 per cent. in money, or City, State, or United States loans of a market value equal to 25 per cent., on which deposit they are allowed the interest. The money or loans are deposited at the contractor's risk in such bank or Trust Company as he and the head of the Department may agree upon.

In contracts which require that the work to be done shall be kept in repair for a specified time after its completion, real estate security or a money deposit of 10 per cent. of the contract price is required during such period.

The Mayor of the city, as well as the head of the Department, must sign the contract.

Contracts shall not be awarded to any party previously a defaulter. Heads of Departments are required to keep a list of the names of contractors who have defaulted or refused to comply with their bids; which record shall at all times be open for the inspection of all persons desiring information. The head of every Department must also immediately notify all the heads of other Departments of every such defalcation or refusal, and they must add the name to their lists.

Printed specifications are in most cases furnished to all applicants, but drawings are generally to be seen only at the offices of the heads of Departments. No drawings are made for street paving or curbing, but complete specifications for each class of work done by the Highway Department are printed separately on paper of different colors (for convenience in distinguishing them). Specifications for sewers are printed in forms, to be filled out with the "cyclostyle;" general provisions, instructions and conditions applicable to many cases, are printed entire, on separate sheets to be attached to the detailed portion after the latter has been filled out. In the Water Department for those classes of work or materials for which there are likely to be but few bids, the specifications are commonly written by the type writer and the manifold process (carbonized paper transfer).

Building Inspection.

The execution of laws and ordinances relating to the inspection of buildings is in charge of three Building Inspectors, one of whom is appointed by the judges of the court of Common Pleas, one by the judges of the Supreme Court of the State and the third elected by Councils, each for a term of three years. The annual salary is $2,000, and bond $10,000. They "shall be suitable persons of experience and skill, each of whom shall have served a

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regular apprenticeship to the house-carpentering or bricklaying business, and afterward been engaged, for at least seven years, in working in or carrying on such business." They also perform the duties of "fence viewers."

Frame buildings are not allowed in any but the most rural portions of the city, except by special ordinance. Permits are required from the building inspectors for the erection or extensive alteration of all except wooden buildings, and the inspectors or their deputies are required to inspect the work from time to time to see that the regulations are complied with; "that the materials used are suitable for the purpose, and that the work is done in a substantial and workmanlike manner, and is of sufficient strength and solidity to answer the purpose for which it is designed."

Following is an abstract of Building Regulations, (ordinances):

Every dwelling house shall have an open space at the rear or side equal to at least 12 ft. square.

The thickness of walls required is as follows:—For those not over 35 ft. high, cellar or foundation walls not less than 16 in.; party and front walls, not less than 9 in. Those from 35 ft. to 45 ft. high, foundation or cellar walls not less than 18 in.; party and front walls not less than 13 in. Those 45 ft. to 55 ft., foundation not less than 20 in.; party not less than 13 in.; and front not less than 18 in., to the height of the first story, and 13 in. the remainder of the height. Those 55 ft. to 65 ft., foundation not less than 24 in.; party not less than 18 in. to the height of the first story and 13 in. the remainder of the height and front 28 in., in the cellar, 22 in., to the height of the first story, and 17 in., the remainder of the height. For buildings above 65 ft. the thickness of walls is to be determined by the board of inspectors. The above rules are subject to the following provisions. "That any lot of the width of 16 ft. or less shall, not be encumbered with more than 9 in. of the stone wall or more than 4½ in. of the brick wall; nor in any case shall any party wall be placed on the adjoining lot more than 10 in. for the stone wall, or more than 6½ in., for the brick wall"; and "That in any case where the proposed building is to be used for a storehouse, the party or division walls shall not be less than 13 in. the full height thereof."

Rear or party walls must not be built on wooden supports. Party walls must be built at least 10 in. above the roof (except in blocks of only two houses with side to each house, and roofing of incombustible material.

The depth and character of foundations is left entirely to the judgment of the inspectors.

Doors of all public halls and places of amusement must be constructed to open outwards or kept open during all performances.

Bay or oriel windows are not allowed to project beyond the building line in front of houses, without special license from Councils, but are allowed on side fronts.

The inspectors are required to inspect all walls and supporters of buildings deemed dangerous, upon the written application of any two citizens, and to order them removed or altered if they deem it necessary for safety.

The following illustrations properly belong under the head of Sewerage in this paper on the Municipal Engineering of Philadelphia, but were at the time omitted. These cuts need little explanation: Fig. 23 shows the details of construction of a man-hole to a large cylindrical sewer, with its wrought-iron ladder-bars and the method of attachment.

Fig. 24 is the common form of catch-basin and sewer-inlet; this is almost invariably placed directly at the street-corner as represented and covered by an iron rectangular plate or frame in which are two rectangular openings, about 18x13 in., (with iron covers) for removing the deposit in the basin.

Fig. 25 shows a cylindrical cast-iron catch-basin lately introduced. It is located at points where but little waste water or garbage from dwellings, etc., is likely to enter, as around the new public buildings. As a consequence very few are yet in use.

Gas Works.—At Asheville, N. C., work on the new gas works will be commenced this month by the New York Contract Co.——Gas works are contemplated at Taylor, Texas, Anniston, Ala., and Eureka, Cal.——Companies have been formed at Memphis, Nashville and Chattanooga, Tenn., to manufacture and use a patent gas economizer; W. T. ARRINGTON, of Memphis, is interested.

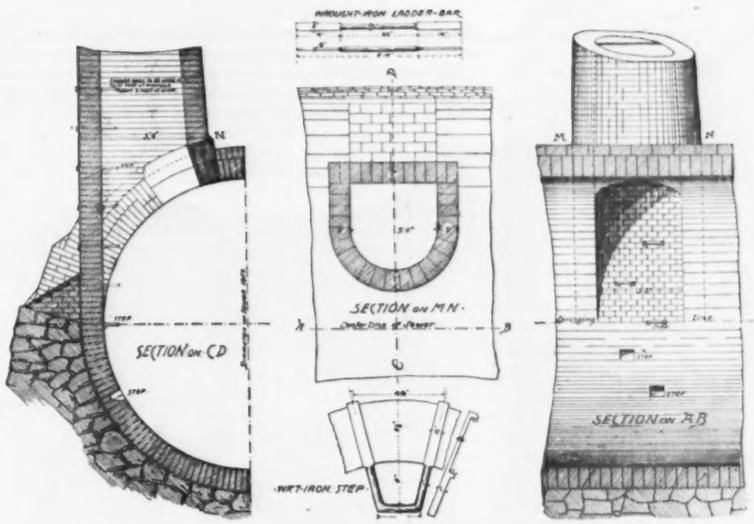


Fig.—23. Man-hole to Large Sewer.

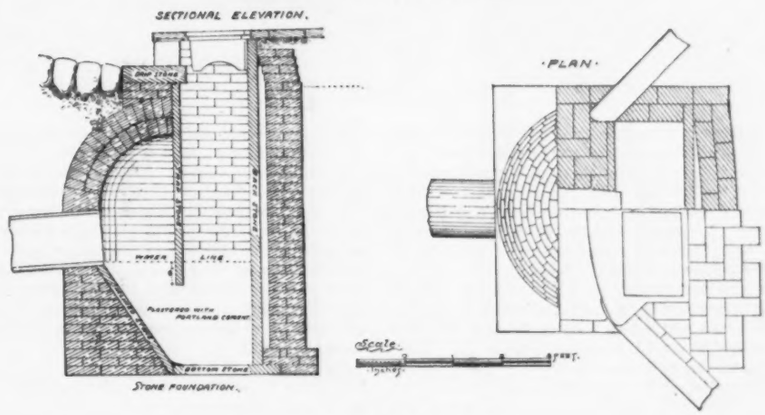


Fig.—24. Standard Catch-basin.

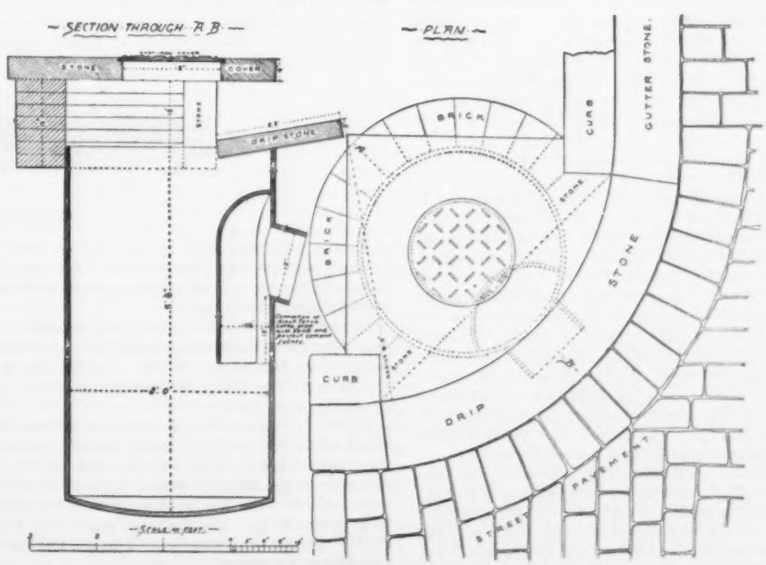


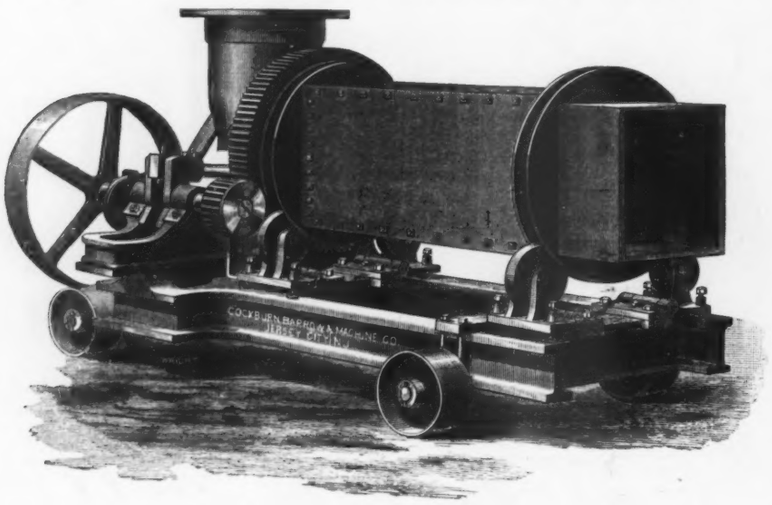
Fig.—25. Cast-iron Catch-basin.

The Modern Telescope is an expensive tool, according to Mr. J. K. REES in his late lecture on "The Great Telescopes of the World," at the New York School of Mines. The total cost of the Lick Equatorial will be $163,800; in this amount the 36 in. object glass (the largest in the world) is set down at $52,000; the photographic lens of crown glass, $13,000; mounting of telescope, $42,000, and dome and machinery, $56,800. The focal length of the Lick telescope will be 56 ft.; length of polar axis, 12 ft.; diameter of polar axis, 12 in., with a cylindrical hole 5 in. in diameter; declination axis, 12 ft. long, 10 in. diameter with 5 in. hole. The tube of steel will weigh about 3 tons; with all its moveable parts, 12 tons. The "head" will weigh 3 tons and the pier 10 tons; making a total of 25 tons. The lenses, with their cell, weigh 700 lbs.; they were made by ALVAN CLARK & SONS, who have just finished a 30 in. object glass for Russia.

A New Concrete Mixing Machine.

The cut given herewith illustrates a newly patented concrete mixer which is in active operation at the foundations of the Harlem River bridge, now under construction.

The machine consists essentially of a rectangular



A New Concrete Mixing Machine.

mixer about 2 ft. square and 8 ft. long; the main portion of which is made of steel plates flush-riveted on the inside and without blades or any other mixing device in the interior. To either end of this steel box are riveted castings as shown; in front this casting is a square box-mouth and the guide or supporting wheel in one piece; the rear casting is made up of another guide wheel and the cogged driving wheel. In the center of this last casting is a conical opening for the entrance of the material into the mixer, and into this opening projects a short distance the conical spout of the cast-iron entrance elbow.

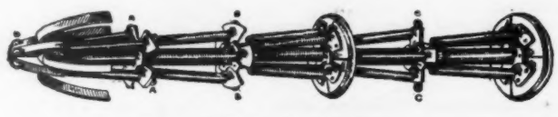
The power for revolving the mixer is furnished by a small engine resting upon the main bed-plate of the machine, and supplied with a fly-wheel and geared directly to the driving-wheel on the mixer. The four carrier-wheels upon which the box turns rest upon separate hinged supports each provided with two set-screws for adjusting the axial position of the mixer: these carrier-wheels are bevelled towards each other, as the pairs stand, so as to keep the box in constant vertical plane without binding.

In use this machine occupies a space of about 10x5 ft. by 4½ ft. high. It is located, for foundation work, on the side of the pit in such manner that the mixing platform rests directly upon the upper flange of the entrance-elbow, and the entire machine is covered up. On this platform the proper proportion of broken stone is first spread out, then the cement and sand placed upon it; the shoveling of this stratified mass into the elbow is all the preliminary mixing that is required. A small pipe with a rose-nozzle enters the elbow just below the flange and passes some distance into the mixer-box on its axis, and through this pipe the requisite water is supplied for making the concrete. As the concrete leaves the front end of the mixer it falls into a hopper-box leading into the derrick-buckets. Continuous work is kept up by providing this box with two branching Y-like chutes, each closed by a stop-plank.

Mr. MYLES TIERNEY, the contractor for the masonry of the Harlem river bridge, has now thoroughly tested this machine in the very extensive concrete foundations for the main piers; he certifies that it has easily mixed 900 cu. yds. of concrete in six working days of ten hours each, or an average of 150 cu. yds. per day. Mr. TIERNEY says that an extended test in actual daily use proves the machine to be strong and durable and he recommends it for any position where hard work and large results at a minimum cost are sought after. Mr. A. NOBLE, Resident Engineer of the Harlem river bridge, endorses Mr. TIERNEY's testimony. Any further information can be obtained from the manufacturers, The Cockburn Barrow and Machine Co., 234-240 Eleventh street, Jersey City, N. J.

A Water Pipe Scraper.

In the last annual report of the Boston Water Board, mention is made of the successful use in that city of a new water pipe scraper. The following illustration, taken from a badly executed original, will show the principle of this device:—



Sweeney Water-pipe Scraper.

The purpose of the machine is to loosen and remove the scale, rust, mud or other deposits in a cast-iron distribution system. The only operating power is the existing pressure in the mains themselves.

In use, a section the length of the scraper is cut from the pipe; the machine is then inserted in a new section, and joined to the main; an opening for the discharge of the refuse matter is made at some point ahead of the machine, and finally the water is turned on, and the scraper forced ahead. As a rule one passage of the scraper through a pipe is sufficient to clean it.

Referring to the cut, the machine has a small head-piece *D* provided with small steel anti-friction wheels; hinged scrapers *A* and *B*, also provided with small wheels; four curved springs at the head to keep the scraper in the center of the pipe, and two driving diaphragms (not lettered) with rubber packing, by which the machine is forced onward. Coiled springs connect each set of scrapers with the preceding body-piece, and by their action keep the scrapers against the pipe, and yet by reason of a hinge in the scraper blade permit each to turn back if it strikes an obstruction.

The whole combination is very flexible, and it will pass through saddle-pipes, and around any ordinary bend either lateral or vertical. The scraper for a 4-in. pipe weighs 13 lbs.; for a 6-in. pipe, 40 lbs., and for a 12-in. pipe, 135 lbs.

Mr. WM. JACKSON, City Engineer of Boston, in a letter of October 11, 1886, states that this scraper was tested for two months in the East Boston district; the pipes there have been in use from 30 to 35 years and had a coating on their inner surface from ¼ to ¾-in thick. Mr. JACKSON says that about 16,000 ft. of this pipe was cleaned by the machine in a satisfactory manner.

The owners of the patent are SWEENEY & SHEEHAN, 238 Water street., Fitchburg, Mass., to whom parties are referred requiring further information.

"STEEL the coming material for bridges, cast-iron mistrusted' stone good in places" is the expressive head-line given by a New York reporter to a published interview on the subject with a civil engineer. Assertion No. 2 will seem somewhat antiquated to the bridge-builder of the present year of grace.

The Overhead System of Steam Heating

An interesting discussion relating to the value of the overhead system of steam heating is contained in a recent Volume of the Transactions of the American Society of Mechanical Engineers.

Mr. WOODBURY, Inspector Fact. Mut. Ins. Co's. relates, in this discussion, how at one time, in the desire of learning the measure of success of these overhead pipes in their practical application, letters of inquiry were sent to those using elevated steam heating pipes, the southern one being in Maryland and the northern one in Canada. Of the forty answers received thirty-eight were favorable; two unfavorable; and of these two, one was where large cast-iron steam pipes were used in a rather low attic room. Mr. WOODBURY reports their use at the present time even in the rag-sorting rooms of paper-mills, where there is no forced circulation of air by machinery.

Mr. GEER, Master Mechanic Cambria Steel and Iron Co. testified that they have a floor in their machine shops, 65 ft. in length by 30 ft. in width, heated by the overhead system, and it had worked very successfully for several cars.

Mr. HENRY R. TOWNE, President of the Yale & Towne Manufacturing Co., warmly attests to the value of the system, and cites in illustration about as severe an example as can be imagined for this system, viz.: the heating of a one-story building, 80 ft. in width by 300 ft. in length, with a center bay having side sashes its whole length, and with an unusual amount of glass and exposure. Although believing in the system, Mr. TOWNE thought that these conditions and the great height of the story made it doubtful whether the overhead system would so fill the upper part of the space as to overflow down into the lower part and properly heat it, and so made provision in his plans to put in floor radiators in case the overhead system failed to operate fully. At the time of his report the system had been in use two winters, and the floor radiators had not been put in and he says would not be.

Mr. TOWNE also related another instance of the installation by him of this system in a large group of new buildings, which three years trial proved so absolutely satisfactory that at considerable expense the old system of heating had been taken out of other buildings under his control and replaced with the overhead system.

Mr. PARTRIDGE related some trials made by him proving the success of the heating arrangements in Mr. TOWNE's shops. He took the temperature at the floor level and 6 ft. above. In the crane shop 6 ft. from the floor the temperature was 70° Fahr., at the floor 68° Fahr. In the packing room 6 ft. up 69°; at floor 65°. Drawing room 6 ft. up 72°; at floor 72°. In most of the rooms he found the difference in temperature of the room between the level of a workman's head and his feet was only 1°; the greatest difference in any room was 4°. One of the rooms had no machinery in it, and would, in his opinion, have been considered extraordinarily difficult to heat by any other system.

Mr. PARTRIDGE points out, at the same time, how easy it is to destroy the efficiency of the overhead method of heating, by an improper arrangement of the pipes, and cites in illus-

tration, the instance of a factory, recently erected on Long Island, in which the steam fitter put the overhead pipes so close to the upper corners of the room that the heat was mostly expended in warming the external air and the building consequently was cold, until the pipes were properly arranged.

Of course, in this, as in all other engineering systems, proper judgment and common sense must be called into play, if success is to be attained. The system works best where forced circulation of air is caused by the motion of the machinery or by special fan or ventilator appliances, The late ROBERT BRIGGS, a leading authority in steam heating, refers to the system, in his latest publication, a paper read before the Institution of Civil Engineers, a few months before his death, in the following words: "Although by this arrangement the heat would apparently be expended in the top of the room, yet very satisfactory results are thereby obtained, in regard both to equability of warming and to efficiency of radiating surface."

Whatever its merit for other purposes, the overhead system of steam heating is certainly valuable for buildings, such as factories, mills, and the like, in which currents of air are produced by the motion of machines in operation.

Refuse Removal in Paris.

In continuation of the articles on "Street Cleaning in Paris" *Engineering* says that the removal of household refuse is a matter of more importance in Paris than in London, owing to the greater density of population and the more considerable consumption of vegetables. Previous to 1870 the Parisians were permitted to deposit domestic refuse on the edge of the pavement in front of their houses early in the morning. In 1846 the nuisance of this manner of disposal was recognized, and the authorities attempted to compel them to keep the waste in the houses until called for. This regulation was renewed in 1870 on account of the public health during the siege. But alike in 1846 and 1870 the regulation was practically a dead letter, particularly in remote districts; it was opposed both by the negligence and ill will of the inhabitants.

A special industry in Paris supports about 15,000 persons and produces from 7 to 8 millions of francs annually. That is the rag-picking (*chiffonage*) carried on at night, and generally worked by a thoroughly honest class who have the sympathies of the press and the people. It was to the interest of this class to leave the refuse in the streets as long as possible, and this fact had great weight in the non-observance of the regulations. Recently, however, the law has been vigorously enforced by the Prefect of the Seine, and in opposition to much clamor by the press and people.

The new rule, dated March 7, 1884, forbids the throwing into the street, either by day or night, any domestic refuse or sweepings from the house; one hour before the official time for collecting, all such matter must be placed in sufficient receptacles either on the pavement or in plain sight in the doorway, and these receptacles must be removed by the tenant as soon as emptied, or within one-quarter hour. The receptacle must have a maximum capacity of 4.23 cu. ft. and not weigh more than 33 lbs. empty; if circular, it must not be more than 21.6 in. diameter; if elleptical or rectangular, the dimensions must not exceed 20 × 31½ in. and the height must not be greater than the smaller dimension; it must be painted or galvanized, have two handles, and bear in plain characters the house number and street name.

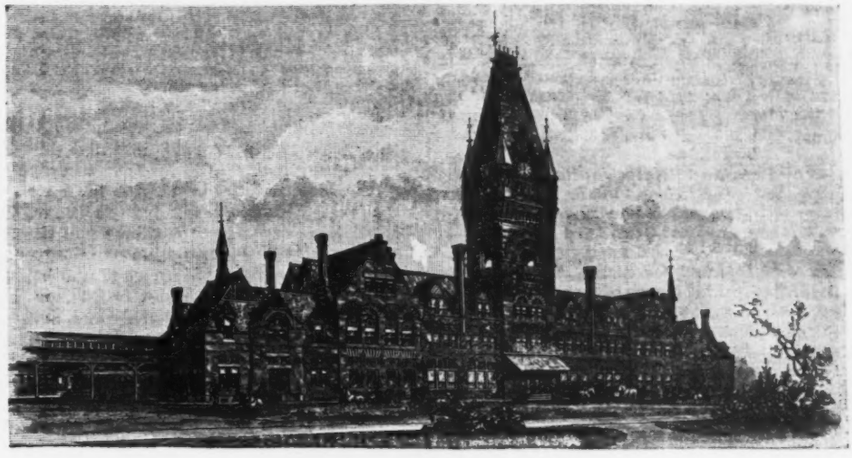
The Management and Care of Wire Hoisting Cables.

The *Compagnie des Forges de Châtillon* has been publishing a valuable and interesting set of rules and tables for the use of wires and metallic cables. Regarding the use and care of hoisting cables, the company says:—If the conditions do not permit the employment of hoisting drums of 16 to 20 ft. diameter, the cables should be of steel of great resistance, and have a safety factor of 10; with cables of charcoal-iron, or soft steel, a factor of 6 can be used, especially if workmen are not to be lowered by it. Every two or three months the drum fastenings should be renewed, and cables should be cut long enough to change this loading point considerably. The tensile strength of the wires in the end should be tested each time the fastenings are shifted, and careful attention paid to broken wires at these points. This being the most abused portion of the cable, if the sum of the resistance of the sound wires exceeds one-fifth of the breaking strain, the cable is still fairly safe; the broken wires in any one metre of cable-length are rejected in such an estimate of strength.

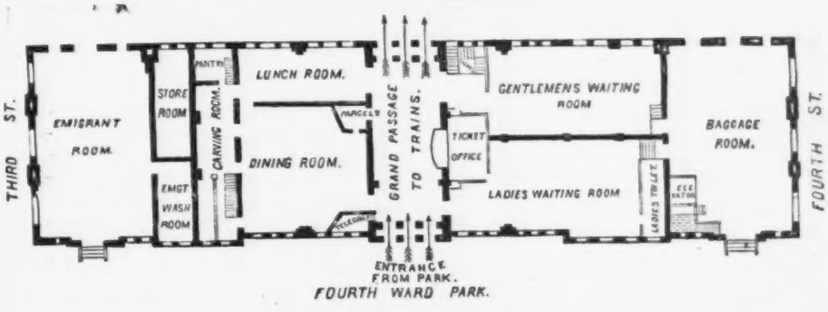
Every eight days and whenever the cable is cleaned the broken wires and frequency of breaks should be noted. When the number of broken wires in a running metre of cable reach one-tenth of the total wires, workmen should not trust themselves to it, but the cable may be used for hoisting material. Every eight days the cable ought to be carefully cleaned, then greased. For the latter purpose the coating should have, in summer, the consistency of butter, and be made of vegetable tar and tallow in equal parts. When this mixture is too stiff a little oil will soften it. Other lubricants can be used, such as heavy oils with tallow; tar and oil and heavy oils with oil of rape-seed (colza). The first named mixture is the best however. If the cable is much exposed to water, this greasing is required more frequently. There should be not more than $\frac{1}{16}$ in. play between the cable in its thickest part and the confining rims of the sheave or drum.

In the form of general but important recommendations these rules warn the user to avoid the lashing or violent lateral movement of cables; quick jerks in starting to hoist; do not let the guides bind; avoid friction of the cable on any object other than the drum: give the drum 20 ft. diameter if possible; examine the cable carefully after any accidental shock or abnormal "side-lash," and look well to the proper condition of the axles of drums and sheaves and their bearings.

IT is again reported that work is to be immediately begun on the Third Avenue Cable Line in New York. The subterranean and aërial projects seem to make little progress.



The New Milwaukee Passenger Station.



General Ground Plan.

PUBLICATIONS RECEIVED.

Locomotives and Locomotive Building, being a brief sketch of the Growth of the Railroad System and of the various Improvement in Locomotive Building in America, together with a History of the Origin and Growth of the Rogers Locomotive and Machine Works, Paterson, N. J. 1886, pp. 200; numerous plates and tables. One of the handsomest and most elaborate locomotive catalogues ever issued in this country, and in many ways the most complete. The technical part of the work of preparation was done by Mr. M. N. FORNEY, and the "Early History of Railroads" and sketch of the "Organic Development of the Locomotive," in particular, is a valuable piece of work, containing information difficult to find elsewhere, and nowhere else collected, together.

Commerce and Navigation of the United States Report of the Chief of the Bureau of Statistics, Washington, D. C. Part I. Foreign Commerce, Immigration and Tonnage, pp. 938, Octavo. Contains tables of the above and of prices of leading articles of commerce extending for many years back.

Transaction, Am. Inst. of Mining Engineers, as follows:—Geological Distribution of Natural Gas in the United States, by C. A. ASHBURNER, General Description of the Ores used in the Chattanooga District, by H. S. FLEMING. Notes on the Saving of Sulphur and Ammonia from Gases, by W. H. ADAMS. Mining Engineering in the University of Illinois, by Dr. T. B. COMSTOCK. Concentration and Smelting at Tomeston, Arizona, by J. A. CHURCH.

Preliminary Report of the Drainage and Water Supply Commission of Chicago, January, 1887. This is the preliminary report of Engineer RUDOLPH HERING and Consulting Engineers BENEZETTE WILLIAMS and SAMUEL G. ARTINGSTALL. We have already published a summary of their conclusions.

Annual Report, Chief of Bureau of Yards and Docks U. S. Navy Department, to June 30, 1886. Includes record of work done during fiscal year and estimates to June 30, 1888; contains an interesting detail of the excavation and removal of coffer-dam at Mare Island Navy Yard, California.

Water-Works and City Reports, Bay City, Mich; Manchester, N. H.; East Saginaw, Mich.; Nashville, Tenn.; Wilmington, Del.

Leveling; Barometric, Trigometric and Spirit. By IRA O. BAKER, C.E., Prof. C.E., Union, Ill, No. 91 of Van Nostrand's Science Series, New York; 12 mo. 145 pp., 50 cts. Some of the more interesting matter in this useful little volume has already appeared in this journal

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

TRIBUNE BUILDING, - NEW YORK CITY.

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D. McN. STAUFFER, A. M. WELLINGTON, EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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IN our pregent issue is a lengthy answer from an authoratative source to Commissioner SPENCER's opposition to the Quaker Bridge dam project as shown in his letter to the *Tribune* of Feb. 23. Commissioner SPENCER has a right to express his personal opinions and engineers have as perfect a right to criticise the same, but we are surprised at the accompanying *Tribune* editorial which charges that this mighty enterprise has been disposed of in "a jaunty and light-hearted way."

The fact in the case is that, as we have before shown, this problem has been submitted to as able a board of experts and engineers experienced in such matters as this country, or perhaps any other, can afford, and when built all details of form and material will be in accord with the latest and most profound theory and practice. The *Tribune* makes the mistake of assuming that the Commissioners are the experts, whereas they may employ experts but are not expected to and cannot act as such individually. The problem to be solved is a "mighty" one, but it is altogether too much so to be successfully discussed and decided epon either by the editorial staff of a paper as powerful even as the *Tribune*, or by non-professionals like Commissioner SPENCER and the Hon. O. B. POTTER. We have excellent grounds for saying that neither Commissioner BARNES nor General NEWTON regard themselves as "the experts of the Commission," as the *Tribune* would infer, but that these gentlemen are willing to abide by the decision of the engineers already consulted.

THE full text of the findings of the Vermont Railroad Commission as to the Woodstock disaster makes it all but certain that a Latimer safety-guard, such as we illustrated in our issue of Feb. 12, would have re-railed the train with perfect ease, and saved the disaster. Their report says;

"At a point 510 ft. from the abutment at the south end of the bridge, while the train was moving at a speed of less than 12 miles an hour (It was more probably 20.-ED.) the rear sleeper Pilgrim was thrown from the rails, *but kept the road-bed until it came upon the bridge*, when the rear end swung to the right side of the track *to the deck of the bridge* and thence to the frozen river below, a distance of 43 ft., drawing with it the sleeper and the two coaches in the front."

To this must be added the absolute certainty that the three cars ahead were also derailed before they reached the bridge, and probably at the same point, because the brakeman in the front car was alarmed by its joltings, and after doing several other things had time to escape to the platform and jump to the ground some distance before it reached the bridge. Actions speak louder than words, or impressions, or opinions, in such cases, and the Commissioners' doubt as to whether there was really more than one car derailed before reaching the bridge is not entitled to credence.

We have then these conditions: Four cars derailed, (as shown by the brakeman's jump) the couplings still holding (as shown by the fact of the train being dragged so far over the bridge) the rear car the most displaced (as shown by the fact that it fell first and dragged the others after it) *and it not badly displaced* (as per Commissioners' finding above and other evidences). Under such circumstances, the chances are, to speak with the most moderate reserve, at least TEN TO ONE that the cars would have been either put back upon the rails in safety, one by one, or kept upon the bridge till the train could be stopped. The only serious doubt in the matter arises from the axle which is alleged to have been broken before the bridge was reached, but as this was the middle axle of a six-wheel truck, and as it is rather more than doubtful, from the facts detailed by the Commission, whether the axle was really broken before the bridge was reached, and not at all necessary to assume that it was, this doubt also was not so serious a one as to make the Commissioners' words on the question, which were as follows, anything but a rather lame and impotent conclusion:

"The subject of the want of a guard rail upon the approach to the bridge has been called to our attention. In view of the fact which we find, that the want of such a rail in no wise contributed to this accident, and the existence of such rail in this case would not have prevented the same, we do not feel called upon to make any recommendation in regard thereto at this time. But it seems proper at this time, and upon this matter, to advise all the railroad companies of the state to take into considera'ion the most approved methods in vogue anywhere for the better equipment of their bridge approaches where needed, with strong buttresses, flaring safety beams, or other practical devices to diminish the fatality of this class of accidents. Such reasonable precautions should be taken before rather than after the occurrence of any fatal calamity."

BUT if the Vermont Railroad Commission was not very happy in its findings, it has redeemed itself by the eminently wise legislation which it has since recommended, in accordance with the request of the Legislature, which is so precisely in accordance with the suggestions which this journal has been alone in making, and with the plans which we have been alone in publishing, that we think we may fairly claim it as the direct result thereof. They have reported a bill providing, first, that after January 1, 1888, it shall be unlawful to heat any passenger car used on a steam road in the State "by a stove or heater attached to the inside or outside of the car which is not so constructed and guarded as to prevent the car from catching fire therefrom under any circumstances."

This is a trifle vague, but it means, if literally enforced, that no fires can be used on cars at all, for no fire on a car can be made *absolutely* safe. The second recommendation, which is really far more important for the safety of the public, if they did but know it, is: "After November 1, 1887, floor systems shall be maintained upon every steam railroad bridge, trestle, or cattle guard so constructed as to support a derailed locomotive or car, *with guard rails or timbers so constructed as to guide the wheels in case of derailment, and guard rails shall be maintained upon the approaches of all bridge and trestles so constructed as to guide the wheels, in case of derailment. Guide-posts shall be placed in the prolongation of the line of bridge trusses so that in case of derailment the posts, and not the bridge trusses, shall receive the blow of the derailed locomotive or car.*"

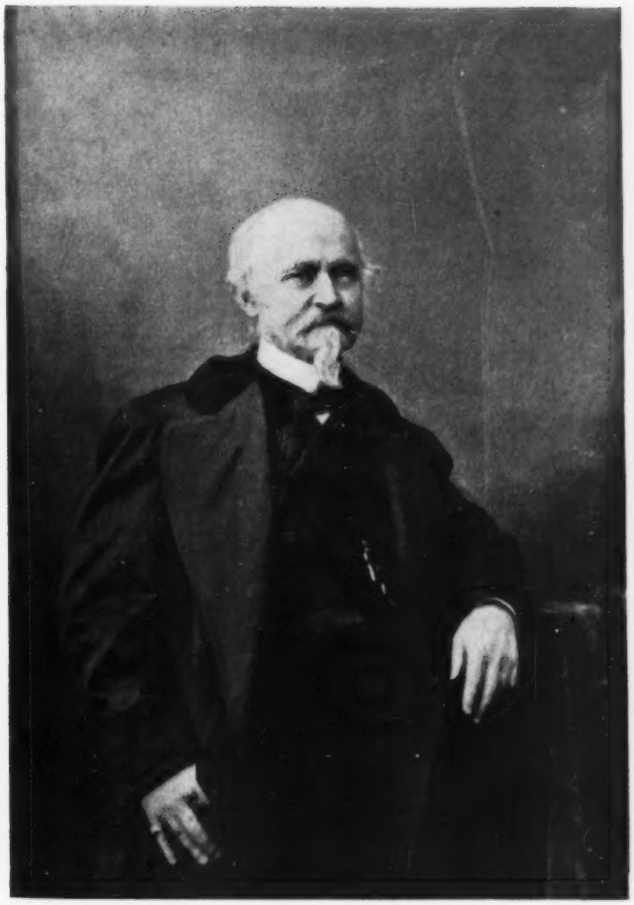
This clearly describes every feature of the Childs-Latimer device illustrated for the first time in our issue of February 12, except that it does not specifically command the use of the re-railing frogs. But as these are at once the most efficacious and the least expensive parts of the device, we may be quite sure that they would not be likely to be omitted if all the rest of the bridge guard were constructed.

The New York Commission has duplicated this action, stipulating in the same words that the safety device which we brought before the public, shall be used on all railroad bridges in the State after November 1, 1887, under a penalty of $1,000 *plus* $100 per day for each day of neglect. But in the discussion of the steam heating question, the Commission was lamentably weak and ill-advised, especially in the following:

Uncontradicted opinions of those competent to judge are, that a stove or furnace can be built surrounded with a jacket of boiler-iron or steel strong enough to resist fracture under *almost* any conceivable circumstances. Strong wire netting surrounded with thicknesses of wire gauze can be arranged to prevent the scattering of live coals. Furnaces suspended under and outside the car would, in case of collision or telescoping, be broken off. Experts say this is an unnecessary precaution, because furnaces can be made strong enough to be pushed through the car in case of collision; and under no circumstances set fire to the car.

With all due respect to the Commission this is, to say the least unproven, and is calculated to do much harm when coming from such a body. Instances have repeatedly happened when trains have been set on fire by coals from the locomotive in summer time, with no fire of any kind in the cars. Is it expected to make a stove for each car stronger than a locomotive fire-box? The truth is that, while great additional security might be and should be secured, nothing whatever in the form of a stove can be made to resist the impact of a collision. The most reasonable plan is one tested in New York this week, a wrought-iron or steel covering to a cast-iron stove within, which is expected to be shattered by a collision, and let the water and steam quench the fire within, before rupture takes place. This would be very effectual in a slow and gradual collision, but for collisions or other casualities of the ordinary kind the element of TIME comes in. The mischief is done, if any is done, "in an instant, in the twinkling of an eye," and it takes a very considerable time for water to quench the fire in a mass of live coals, when the same force which releases the water is acting behind to scatter the coal.

The commissioners have been sadly misled by their technical advice in this matter, and the case would have been still worse had the statement been true which they make just before they condemn steam heating, that "the



I remain
Yours Truly
W.W. Evans

loss of steam was insignificant," being only from "one-half to one per cent" of that generated. This they plainly took from the testimony of Mr. JOHN W. CLOUD, and he as plainly from the article in the *Railroad and Engineering Journal* which we had occasion to correct, for it is impossible that so able a man could have computed the loss of steam at only a fifth to an eighth of the proper amount *and* have chanced to hit on the precise degree of error which had appeared the week before in print. To conclude that heat can be had from the engine which costs nothing and is perfectly safe, and yet that the engineering difficulties in getting the steam from the engines to the cars cannot be overcome, is to reduce engineering to an absurdity, and engineers and mechanics to a race of weaklings.

The Massachusetts Commission has also sent out a special letter of inquiry on the question of bridge-guards, and the legislatures or railroad commissions of nearly a dozen other States, and eighteen different roads which we know of, have made some move on the question of car heating. Included among these roads is the Vermont Central itself, whose President has experienced a change of heart since his first unfortunate letter. He now declares: "The managers of the road have given the subject of car heating careful consideration *since their return from Hartford*, and * * * have closed a contract to-day with R. G. CHASE, of West Medford, Mass., for equiping a train with the Williams system of car heating with steam from the engine. The Williams plan has been carefully examined by the managers. It was decided to make a thorough test of the system, and in order to do so, we have ordered the local passenger trains, Nos. 5, 8 and 59, running between St. Albans and White River Junction, to be equipped with this system."

The Williams system is quite elaborate, there being a double circuit of the pipe from the engine to the rear car, and back on the other side to the engine again, where a steam air pump, something like the Westinghouse pump, is used to maintain circulation and bring back the steam and condensed water. Whether so elaborate a scheme has enough advantages to compensate for the complication cannot be judged from the description, but certainly it is not found essential in other systems, which simply let out the water of condensation by a steam-trap under each car.

THE *New-York Times* refers editorially to the very much needed change, and improvement in the present methods of indexing real estate in New York City. The Bar Association is now struggling with the question of system, whether it shall be by the lot or block, advocates of both systems having submitted plans of procedure to the Legislature. The whole question of improvement seems to be in about as muddled a condition as the real estate records are themselves.

In this connection we would mention that we will in our next issue commence the publication of the system of real estate registry adopted in the City of Philadelphia. This system has been the outcome of careful study and an adjustment of troublesome and conflicting conditions, and has been tested by nearly twenty years of use. It is sufficient commendation of the practical working of the scheme to say that any one by simply giving to the clerk of the Registry Bureau the location of a lot in question, can have laid before him *in two minutes* a complete record of ownership, back to the original grant or to a sheriff's sale. This record and the accompanying plan will show all lots, and subdivisions, no matter how complicated, and supply a complete and official chain of title. On December 1, 1886, the 150 books of the Bureau contained the record of 489,771 lots and transfers.

This is a state of affairs of which Philadelphia can justly be proud, and we would recommend a careful study of the same by the officials of New York before they settled upon any definite plans for improvement.

THE question of form of street railway rail has been lately looming up again in the daily press, and while it is an old, very old, story, we can not refrain from adding our word of comment. The present and almost universal form of this rail in the United States is simply abominable; it is provided with either a side or a center projecting head ingeniously arranged, in the best manner possible, to seriously interfere with all other than street-car traffic. If this was the only section possible to meet the demands of such a railway the importance of this class of public conveyance might be taken as an excuse for its being. But it is not the only form, and its use is never permitted on the travelled highways of English and Continental cities.

In England any other than a grooved rail is forbidden; and long experience has shown that little, if any, inconvenience attends its use and the tracks can be utilized by any other wheeled vehicle without th difficulty attending a "turn-out" from our tracks or the danger of wrenching off a wheel in the said operation. The conditions requisite there are a center groove, too narrow to admit ordinary wheels, and a sufficiently wide rail surface to permit the travel of drays without crushing down the adjoining paving. The great objection made in this country to the groove is that it will accumulate dirt and ice; but this difficulty is met abroad by a much more substantial roadway in the first place and personal attention to it afterwards. One man, provided with a lipped shovel, will care for some miles of track; and we hear of no trouble on the score of dirt in the grooves.

IF the Inter-State Commerce bill should accomplish one result, which there is some promise that it will, the abolition of free passes to all but railroad employés, it will by that alone have justified its existence. The free pass system has been for years a crying abuse, and heavy burden on the revenues of the companies. President ADAMS, has recently declared that the Union Pacific alone has issued passes to the value of $700,000 per year, which is at the rate of nearly one-sixth of the passenger revenue. While this gives an exaggerated idea of the real loss, because many trips taken on passes would not have been taken on a paying basis, it does represent unquestionably an enormous deduction from revenue, which benefitted chiefly those least needing or meriting such charity.

ONE of the railroad papers is publishing a long series of very learned looking articles, copyrighted, on the "Development of Transportation Systems in the United States." It takes a little off the great credit which the compiler would otherwise be entitled to, that the articles are merely a verbatim copy, without credit, of the statistics published in the 1883 Census volume on Railroads, a mere running comment being added! The record thus buried out of sight in a volume which few people have ever seen is a valuable and interesting one, but the appropriation of it without credit is a new device in technical journalism.

AN interesting bill, which reads like a take-off, but is not, was introduced to the attention of Congress by Representative WHEELER on Jan. 10, becoming "H. R. 10423," and is in the following words, which will not bear abridgment:

A BILL appropriating money for the purpose of ascertaining the peculiarities of the formation and structure of the earth's crust.

Whereas the United States have expended large sums of money in exp ditions designed to reach the North Pole, in explorations of the river Amazon, for the purpose of observing the transit of various planets, and for innumerable other purposes, all designed to increase the sum of the general and scientific knowledge of the world; and

Whereas no effort has ever been made by this or any other government to in any way enlighten the people as to the conditions which exist 5,000 ft. below the surface of the earth; and

Whereas it is probable that highly advantageous and immensely valuable results might be obtained by such attempt to penetrate to a considerable distance below the earth's surface or crust: Therefore,

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, that the sum of $100,000, or so much thereof as may be necessary, is hereby appropriated and set apart, out of any money in the treasury not otherwise appropriated, to be expended, under the direction of the Secretary of War, in boring into the crust of the earth, with a view to extending and enlarging our knowledge of the features and peculiarities of its formation and structure.

SEC. 2. That the point at which the boring shall be made shall be chosen by a board of officers of the corps of engineers selected for the purpose; and they are hereby invested with the authority of choosing, at their discretion, that point at which the boring will, in their opinion, be most likely to add to the knowledge now possessed upon the subject; but they shall not select a point within the limits of any incorporated city, town, or village.

SEC. 3. That before the boring is begun the United States shall secure title to the land upon which it is to be made, for at least four miles in every direction from said boring, which title must be approved by the Attorney-General; and unless the point selected shall be upon land owned by the United States, preference shall be given to localities where land is comparatively of small value.

SEC. 4. That the Secretary of War shall make a report to the Fiftieth Congress showing the progress of the boring up to the date of the report, together with the views of the board as to the depth to which, with the mechanical instruments and appliances at their command, it can be carried; and that the estimates submitted by the War Department for the ensuing year shall include an estimate of the amount necessary to prosecute the work during the fiscal year ending Jun 30, 1889.

The bowels of the earth ought to be obliged to Mr. WHEELER for his very practical interest in them.

The Proposed Detroit River Bridge.

There is certainly a good deal to be said for such a "winter bridge" at Detroit as we illustrate in another column. That there is great need of some better means for crossing the river at Detroit is evident, and as this need is felt most in the winter, when there is no river commerce to be interfered with, the plan suggested has much to recommend it. The precise method for removing the heavy "winter span" is not very fully outlined as yet, but we observe that very careful draw-span provisions have been made; so that if the winter span should chance to stick, or other insurmountable obstacle arise to its removal, vessels can still pass the bridge.

But after all, such a plan only half meets the necessities of the occasion. A tunnel under the river, if once built, would be far more advantageous to the railways, and rather more so to the shipping interest, since there would be no obstruction at all to navigation, although the "winter bridge," as proposed, could not be a very serious obstacle. The plan of tunneling far under the bed of the river, through the solid rock, has already been faithfully tried and necessarily abandoned, for the reason that the rock was found to be anything but solid; but from the section of the bottom given on the plan, this would seem to be the place of all places for a chilled cast-iron tunnel, laid by the moveable caisson plan of Mr. H. H. HALL, to be successful, and if there are any insurmountable engineering obstacles to the successful carrying through of such a plan at this locality, we fail to perceive them. It is true this plan has not as yet been used for the construction of a railway tunnel, but it has been used with much success for laying large water pipe in a greater depth

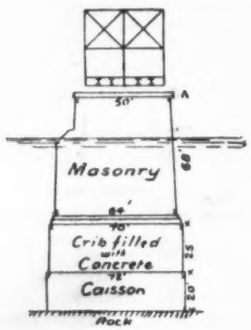
of water than at Detroit, and the laying of a tube of larger size would have certain advantages, as well as disadvantages.

We have dotted in on the cut an imaginary grade line for the top of such a tunnel, which would need to be about 18 or 20 ft. in diameter. Its bed, it will be seen, would lie entirely in the clay, and the dredging to be done in front of the caisson plow would be entirely in mud or in this clay. The total length under the water would be only 2,600 ft., and the greatest depth below the surface, some 65 ft., which would cause no very threatening water pressure, while the rise from the lowest point of the tunnel to the grade of the tracks on the shore would be only some 85 ft. This rise could be readily made within half a mile, without constituting any serious obstacle to the ready handling of as heavy trains as could be reasonally desired, including all passenger trains of any kind.

This results from a fact which is not always given due weight in studying such projects; the aid which may be derived from momentum. Let us suppose, for example, that we had the following distribution of grades on such a work:

WEST APPROACH.	UNDER THE RIVER	EAST APPROACH.
Drop of 85 ft. in 2,700 ft.	2,000 ft. level	Rise of 85. ft. in 2,700.

A drop of 85 vertical feet will communicate to a train, if it starts from a state of rest, a velocity of 48.93 miles per hour. About 13½ ft. of



The Proposed Winter Bridge at Detroit. (*See page* 161)

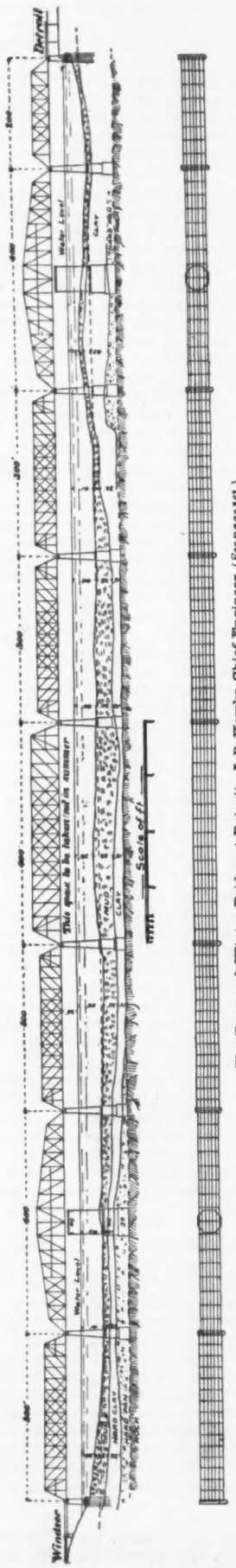
this fall, however, would be used up by an average train resistance of 10 lbs. per ton, on the descent, making the resulting velocity when the bed of the river was reached that due to 71½ ft. fall, which is 44.88 miles per hour.

This velocity will plainly be enough to carry the train under the bed of the river without using any steam. Really, it is much more than sufficient. Allowing the average train resistance at that speed in a tunnel to be 20 lbs. per ton, equal to a 1.0 per cent. grade, 20 vertical feet only of the "velocity head" in the train will be used up on the level, making the velocity at the end of the level under the river that due to 51½ ft. of "head," which is 38.09 miles an hour.

It is probable that the air resistance in such a tunnel would be so great that the heaviest train would not attain a velocity of over 30 or 35 miles an hour, but neglecting that for the moment, if the velocity of 38 miles per hour were attained, all that velocity, thus stored in the train, would be available to help the engine out in pulling the train up the otherwise difficult incline.

The total rise from the tunnel being	85 ft.
And the "head" still in the train being	51½ "
There remain only	33½ ft.

through which the power of the engine must lift the train, which amounts to a grade of $\frac{33.5}{27} = 1.24$ per cent., or 65 ft. per mile, which is so mild a grade that, even with a less initial velocity there would be no difficulty in handling any passenger train on it without using any steam in the entire passage, excepting the last half of the rise. Even freight trains would need to use no steam till the rise had been begun, and consequently ventilating difficulties would be reduced to a minimum.



The Proposed Winter Bridge at Detroit. I. D. Hawks, Chief Engineer, (*See page* 161.)

Thus a tunnel lying immediately on the bed of the river would be a very different matter to operate from one lying far down in the rock. There remains the question of the practicability of laying such a tunnel and of its durability after it was laid. As respects the latter point, time alone can definitely prove it, but the evidence seems to be strong that the chilled grey cast-iron, cast directly from the stack, like pig metal, is not only very cheap, but is practically incorrodable under water. At any rate its corrosion must be slow, while the loading of rip-rap which is desirable to overcome the buoyancy of the tube would serve to protect it from accidental damage.

One feels a certain hesitation in suggesting the use of a device which cannot be said yet to be of proven efficacy for such a locality, but there is at least a strong probability that it will be used for a work of far greater difficulty in every way, a tunnel connection of Prince Edward's Island with the main land, and there is this to recommend a trial of the plan in such a locality as Detroit, that a test of its practical merit involves no very large expense of either money or time, and if not found practicable it can be readily abandoned.

We may be unduly influenced by the great engineering interest which such a work would have. There is a wide field of usefulness for any satisfactory and economical plan of laying tunnels on or just below the bed of rivers and harbors, without being obliged to go down so far below the bed to strike strata which are impervious to the water above it. It seems as if it should not be and was not beyond the reach of science to fill this need, although it must be admitted that it so far has not been filled. Tunnel or bridge at Detroit there plainly must be, and the strong probability that a tunnel may be constructed at Sarnia before long, where the bed of river is more favorable for a rock tunnel, will help to force an early solution.

PERSONAL.

C. C. CHANDLER has been appointed Chief Engineer of the Ohio & Mississippi R. R.

ALEXANDER ABEND, engineer of the City Water Co., of Belleville, Mo., has been appointed to a position as engineer on the Tennessee Midland R. R.; he will be located at Knoxville, Tenn.

WILLIAM PATTERSON, recently with the St. Paul, Minneapolis & Manitoba R. R. Co., has been appointed Master Car Builder of the Minnesota & Northwestern R. R., with headquarters at St. Paul, Minn.

H. PIERCE has been appointed Engineer of Maintenance of Way of the Cincinnati, Hamilton & Dayton R. R., with headquarters at Cincinnati, O.

ELLIOTT HOLBROOK, Superintendent of the Hartford Division of the New England R. R., has resigned his position.

Mr. WM. O. SEYMOUR, for a number of years past Chief Engineer of the New York & New Haven R. R., was nominated on March 1 as Railroad Commissioner of Connecticut, to succeed Mr. JOHN W. BACON, whose term expires.

Mr. JOHN G. VAN HORNE, the former partner of the late Mr. SULLIVAN HASLETT, has associated with himself in the profession of civil engineering Mr. CHAS. E. JACKSON. Both are Members of the Am. Soc. C. E.

Mr. WM. F. SHUNK, late Associate Engineer of the South Penna. R. R., and well-known to American engineers everywhere, has opened an office as Consulting Engineer in connection with Mr. A BRYSON, M. Am. Soc. C. E., at No. 1 Broadway, New York City.

JAMES D. LAYNG, now General Manager of the West Shore, has been elected President of the "Bee Line." Mr. LAYNG is a Pennsylvanian by birth, and began his railway career as a rodman in the engineer

corps of the Ohio & Pennsylvania R. R., now part of the Fort Wayne road. He has held successively the offices of Superintendent of the Eastern Division of the Pittsburg, Fort Wayne & Chicago, Assistant General Manager of the same railway, General Manager of the Pennsylvania R. R., and General Superintendent of the Chicago & Northwestern R. R., which he left in January, 1881, to become General Manager of the West Shore.

M. S. BELKNAP, General Superintendent of the Georgia Central R. R., was made General Manager of the entire system. The position of General Superintendent is left unfilled. Mr. BELKNAP is a Civil Engineer of long experience and a member of the American Society of Civil Engineers.

Walton White Evans.

(With Portrait.)

The late WALTON WHITE EVANS, whose earnestness as an advocate of American railway practice made his name almost as well known in England and on the Continent as in his own country, came of staunch American stock. He perpetuated in his own the name of his grandfather, Gen. ANTHONY WALTON WHITE, of Revolutionary memory, and through his mother he was connected with the VAN RENSSELAER family, of New York; his father belonged to a family long resident on the Eastern Shore of Virginia.

Mr. EVANS was born in New Brunswick, N. J., in 1817, and graduated from the Troy Polytechnic Institute in 1837. His first work as an engineer was on the Erie canal and on the old Harlem railroad. But in 1849 he accompanied Mr. ALLAN CAMPBELL to Chili, as an assistant in the location of a railway between Santiago and Valparaiso, and on the return of Mr. CAMPBELL to the United States, about a year afterwards, Mr. EVANS became the Chief Engineer. This road was about 243 miles long, and was built by the famous English contractor BRASSEY and two associates of London.

About 1851 Mr. EVANS was engineer of the Copiapo Railway, the first railway built south of the equator in South America. It crossed the Great Desert of Atacama, 50½ miles to the town of Copiapo and was intended for the shipment of copper and silver ores. The road commenced at the bare coast without a habitation of any kind near, and even the water used by the workmen had at first to be transported 600 miles by sea. Mr. EVANS completed the road in two years time, provided with all the side tracks required for a heavy traffic, with handsome passenger stations, commodious and well equipped shops that were capable of repairing the English mail steamers as well as the machinery of the road, villages of good houses for the workmen, etc. At Caldera Bay he built the first ocean pier on the Pacific coast of that continent. This pier had 30 ft. of water alongside and carried four railway tracks, costly distilling apparatus for providing water for the engines and town, and great ore bins; it cost $70,000. At the pier was also a coal deposit of a capacity of 20,000 tons. The total cost of this railroad with all the accessories noted was $1,250,000.

As a contrast to this really economical work of Mr. EVANS, performed under very unfavorable circumstances, we may note the results accomplished by English engineers who at that same time were building a railway from Callao to Lima, in Peru. This road was 8¾ miles long, and over smooth ground with a very uniform ascent, like the Copiapo road it, too, lay in a rainless region. The line was finished in two years at a total expenditure of $900,000; and for this sum the company had a single-track road of the length noted with three or four short side tracks at the ends; it had four small engines, about twenty passenger cars, but no freight cars; the passenger station at Callao was made of mats stretched on poles, and in Lima the cars ran into the *patio* of an old church; they had no shops or tools for repairs, and it was not until ten years after the line was opened that any attempt was made to take the freight traffic from the mules and carts. Some part of this excessive cost is explained by the fact that the English engineer, with characteristic adherence to English practice, expended nearly $200,000 in hauling shingle from the beach so that he might place 20 in. of ballast in his road bed; and this in a region where rain and frost were unknown and provision for any drainage was simply a useless waste of money. The record of this English road as given is taken from Mr. EVANS' M. S. S.

About 1856 we find Mr. EVANS engaged in building the Arica & Tacna Railroad, in the extreme south of Peru, for a London company. This line rose 1,800 ft. in a distance of 40 miles, and something over $4,000,000 was expended in its construction and equipment. Many and serious obstacles were here encountered and successfully met by the engineer. In the first year he lost 25 per cent. of his men by yellow fever in four weeks; in the second year the town of Arica was several times taken by storm in one of the chronic Peruvian revolutions, and these events again cost him good men; the 800 Chinese coolies, brought at great expense from Amoy, reached Arica after the road was completed, and the Quicha and Amara Indians, that he employed as workmen, were frightened back to their mountain homes by the revolutionists. Well might Mr. EVANS say, in a letter referring to these experiences, "Oh! but I had a time with that road."

When the road was finished it was equipped with engines designed by Mr. ED. WARD, past Vice-Prest. Inst. C. E., but their performance was very bad, and in six years the road was bankrupt and sold out to the Copiapo Co. The new owners put American locomotives, made by ROGERS, on the line, and made it a very successful enterprise. Mr. GOULD, the then engineer of locomotives of the Copiapo Co., in writing to Mr. HUDSON of the Rogers Locomotive Works, said that the American engines hauled 50 per cent. more load with 20 per cent. less fuel than their British predecessors over the same line. The first cars sent out from England were all rejected by Mr. EVANS and American cars substituted for them. Mr. EVANS said that these cars were the roughest affairs he had ever seen for any similar use; the ends of the axles were *square* and the wheels fastened on with wooden wedges. These wheels were loose on their axles within 48 hours after leaving the shop, as any engineer might have expected they would be in the highly rarified air of this rainless region.

In 1856 Mr. EVANS returned to the United States for a comparatively short time and was married to Miss ZIMMERMAN, the daughter of the Consul General of Holland to the United States. But he returned to Chili and remained there until 1860. Again coming to the United States he for some years acted as the agent and consulting engineer of HENRY MEIGS in all his vast South American railway enterprises, aggregating in cost $130,000,000.

Mr. EVANS was from first to last a sturdy advocate of the American locomotive, and did perhaps more than any other individual to publish its merits to the world. As long ago as 1857-58 he instituted at his own expense competitive trials in Chili with other types of engines, and came out victorious in what was then a much discussed contest. As consulting engineer for foreign governments, and in connection with English engineers, he was instrumental in introducing, into Australia especially, engines, cars and bridges of American design and manufacture. He it was who induced Mr. MAIR, the engineer-in chief of South Australia, to accept a railway viaduct from the Edge Moor Iron works, of Edge Moor, Del., for the sum of £13,000 erected, as against the lowest English tender for the same of £32,000. This award was most indignantly received by the Australian Parliament, and some went so far as to propose to pull it down when half finished and consign it to the scrap-heap. Being advised that they had better wait for the test, all Adelaide turned out on the appointed day to see the "American trap" totally demolished. The viaduct was 90 ft. high and on a curve, but to the astonishment of all, and chagrin of some, it stood the severest tests, including the running on to it of their heaviest consolidation engine at 48 miles per hour and then whistling down brakes at the center of the bridge.

Perhaps the last professional call upon Mr. EVANS for his professional experience was his appointment as one of the Commission to decide upon the plans submitted for the Hawkesbury bridge in New South Wales, which is being built by the Union Bridge Co., of New York; failing health compelled Mr. EVANS to decline the appointment. He was a voluminous writer, and aside from the multitude of papers and pamphlets publishing the results of his professional experience, and his earnestly expressed views concerning American manufactures, he found leisure to privately publish several historical and biographical sketches, the most extended being a "Life of Gen. KOSCIUSKO." By virtue of his descent from Gen. A. WALTON WHITE, Mr. EVANS was a member of the Cincinnatus; he was a member of the American Society of Civil Engineers from date of Dec. 4, 1867, and of the Institution of Civil Engineers from Dec. 6, 1870. His death occurred at his residence "Sans Souci," near New Rochelle, N. Y., on Nov. 28, 1886. Of his family of two sons and one daughter, the latter alone survives.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers. The meeting of the Society on last Wednesday evening, was presided over by President WM. E. WORTHEN, and the attendance was unusually large, many distinguished visitors being present. The attraction was the presentation of a paper by Mr. WM. METCALF, Member of the Society, on *Steel; some of its properties; its use in Structures and in Heavy Guns*, which was read by the author after the routine business had been transacted. Mr. METCALF, in a clear and able manner, set forth the peculiar properties of steel, and discussed its behavior under various methods of treatment, from the standpoint both of his long personal experience and the experience of others at home and abroad. It is impossible at this time to enter into any detailed report of his remarks, more than to mention that the true purpose of the paper was to throw some further light upon the very important and now much discussed question of the proper material, and method of construction of heavy guns. The author was opposed to built-up guns made of oil-treated steel of high tensile power, or to the hammering of the metal in such guns; and he strongly advocated a return to the methods of Rodman in gun-making, with the substitution of mild steel for cast-iron. In a word, he would make his heavy guns by casting them in a pit, breech down, with an internal core cooled rapidly by a water-coil, and an external fire in the pit around the gun, so that all cooling effect would pass from the core outward, and all the inner layers of the metal be in great compression with the outer parts in tension. This casting should have a heavy pouring head of surplus metal, so that static pressure alone, in connection with a proper adjustment of heat, should bring about that same perfection of mass, and arrangement, and form of crystals as is now intended to be secured by hammering. He would not hammer the metal at all, and proved by foreign experiments that the same qualities could be obtained by annealing the steel as by hammering it. As to cost of manufacture Mr. METCALF said the Rodman 15 in. iron gun cost 13⅞ cents per pound, and the 10 in., 9¾ cents. There are now in this country a number of founding plants, which only need the construction of proper pits to enable them to cast 40-ton steel guns; and at present prices he thought a 40 or 50 ton-steel cast-gun could be made for 6 cents per pound. On the other hand, rough-bored, rough-tempered steel in the form demanded by specifications, based on foreign practice, would cost 40 cents per pound, and it would cost just as much more to finish them; this was very near the price of the Krupp guns. And moreover the government specifications allow 30 months for the manipulation of a quantity of material that would only be a two-days out-put from an average Bessemer plant handled according to his proposed method.

The first speaker who responded to Mr. METCALF was Lt. DANNENHOWER, U. S. N. He commended the paper as an able contribution to the gun question, and said that what the navy wanted was the best gun at the lowest cost, and hoped that the steel manufacturers could and would make a gun that would realize all the promises made for it by Mr. METCALF. He defended high steel and sketched out the changes in gun-making since 1865; we then had the best guns, but an initial velocity of 1,400 ft. per second was sufficient and deemed high; now the conditions of service demand 2,100 ft. The new built 6 and 8-in. steel guns of the Navy, though modeled on foreign types and experience, are very good guns and give the requisites of high velocity and minimum breech pressure; the initial velocity being 2,105 ft. and the breech pressure about 14 tons in a 6-in. gun with a 250 lb. projectile that will pierce 12 in. of iron at 2,000 yds. He doubted somewhat the effect of the annealing process upon the condition of tension in the gun cast on Mr. METCALF'S method, and in defence of the foreign built gun said that out of 17,000 guns made by Herr KRUPP only 17 had failed.

Mr. METCALF in reply said the cast gun could be annealed and re-annealed at a red heat as often as required to bring the metal into just the proper condition: and that, moreover, test-rings could be cut from the pouring-head and tested at each stage of the operation in such manner that the ultimate value of the metal could be positively determined. He claimed that with high steel bands shrunk upon a gun it was impossible to know just what the strain would be when cooled, no matter how closely this had previously been figured; high-steel was as sensitive as mercury to

changes of temperature. As to gun bursting records Mr. METCALF said that he had cast 100,000 tons of metal into Rodman guns, and *not one* of these guns had failed, so that he was 17 ahead of Herr KRUPP.

Capt. F. V. GREENE followed, but remarked that as a representative of the army he could only say that while the navy had a number of very good modern guns the army had none. Commander ROBESON of the U. S. Navy inquired as to the comparative weight of steel cast-guns and built-guns, as weight and length of guns were very important factors in the armament of ships. To this Mr. METCALF replied that his remarks applied to heavy guns, not 6 and 8-in guns, and that when it came to 100 tons guns, and upwards that the experiments referred to in his paper showed weight for weight even better qualities than those demanded by our ordnance specifications. Mr. ROBERT W. HUNT, of the Troy Steel Works, said that he had never made guns, but from his knowledge of the properties of steel and the behavior of hammered vs. cast shafting, he thought that the position of the author of the paper was well taken. As to steel-makers casting guns at their own expense to test their theories, he remarked that while he was patriotic he was also a tax-payer; and that if the makers are to furnish information for the public good, the public can afford to pay for it. Maj. MILLER of Governors Island made a few remarks, and then Capt. O. M. MICHAELIS, of the U. S. Ordnance Department, strongly endorsed the views expressed in the paper. Col. CHURCH, editor of the *Army and Navy Journal*, said that he had gathered information on this subject from parties representing both high and mild steel and they both agreed that the cast-gun was a proper thing and probably the gun of the near future. The lateness of the hour made it necessary to postpone further discussion of the subject and the reading of communications upon it until the next meeting. That the topic was a very live one, was evident from the interest taken in it, and Mr. METCALF's paper will doubtless result in a full and exceedingly valuable presentation of the views of both parties to this controversy.

Among the visitors present were the following: Maj. M. P. Miller, U. S. A., Lieutenant John W. Danenhower, U. S. N., S. Dana Greene, U. S. N., Commander H. B. Robeson, U. S. N., Lieutenant Vodges, U. S. A., W. F. Mattes, Chief Engineer Lackawanna Iron & Coal Co., and Dr. Richard J. Gatling. Letters discussing the paper were received from Senator John T. Morgan, Lieutenant R. R. Ingersoll, Head of Department Ordnance and Gunnery, U. S. N., Joseph Morgan, Jr., Cambria Iron Co., Chas. E. Munroe, U. S. Torpedo Station, Newport, R. I., and Lieutenant Austin M. Knight, U. S. N., Inspector of Ordnance, Annapolis, Md.

As a result of the ballot taken the following gentlemen were declared elected to their several grades:

FOR MEMBERS:

DAVID FREDERICK MAXWELL, formerly Assistant Engineer Chatham Branch, Ry., Kent Northern Ry., Grand Southern Ry., New Brunswick Ry., New Brunswick, Canada; Chief Engineer St. Croix and Penobscot Ry.; Resident Engineer Construction St. Croix Cotton Mill Works; Resident Engineer Gibson Cotton Mill; recently Chief Engineer Northern and Western Ry. of New Brunswick; now Chief Engineer Government Railways Province of New Brunswick, Canada, St. Stephen, N. B. Canada:

SILVANUS MILLER, JR., formerly engaged on Surveys and Construction Suburbs of New York City; also on Erie and New England; New Haven, Middletown and Willimantic; New York, Utica and Ogdensburgh; White Plains and New York; Southern Westchester; New York, Housatonic and Northern Railroads; afterwards on Ferro Carril de Costa Rica; Railways in Nicaragua, Guatemala and Salvador; Mining Engineer and Superintendent of Mines in Salvador; Chief Engineer Ferro Carril del Norte; recently Chief Engineer for American Cantracting and Dredging Company on Panama Canal, Hatfield, Mass.:

GEORGE SULLIVAN MORRILL, formerly Assistant Engineer Construction Duxbury and Cohasset Branch and Cape Cod Division Old Colony R. R.; recently Assistant Engineer Old Colony R. R.; and now Chief Engineer Old Colony R. R., Boston, Mass.:

GEORGE FREDERICK SIMPSON, (Cornell Univ. 1879.) formerly on Pueblo and Silver Cliff Ry.; New York, Ontario & Western Ry.; with New York Steam Co.; recently Assistant and Resident Engineer for Foundation and Pedestal of the Statue of "Liberty Enlightening the World," Bedlow's Island, New York Harbor, now residing at New York City.

JOHN THOMPSON, Mechanical Engineer, formerly of Rochester, N. Y., and connected with Colt's Patent Fire Arms Manufacturing Co.; recently Engineer New York Electrical Subway Commission, now Engineer Consolidated Telegraph and Electrical Subway Company of New York City.

FOR JUNIORS:

GEORGE HERBERT LEILAND, Assistant Engineer with J. Herbert Shedd, M. Am. Soc. C. E., Providence, R. I.

JOHN MUIRHEAD STEWART, (Sheffield Sci. School, 1874.) Assistant Engineer Aqueduct Commission, Dobbs Ferry, N. Y.

ARTHUR SMITH TUTTLE, (N. Y. Univ., 1885.) Assistant Engineer Department of City Works, Brooklyn, N. Y.

SCHUYLER SKAATS WHEELER, formerly with Jablochkoff Electric Light Co.; United States Electric Light Co.; Edison Electric Light Co.; and Edison Electric Tube Co.; now Superintendent "C. & C." Electric Motor Company, New York City.

CORRESPONDENCE.

The Quaker Bridge Dam.—What President Spencer Says of it.

NEW YORK, Mar. 1, 1887.

EDITOR ENGINEERING NEWS:

There is ordinarily but little profit in criticising a newspaper article which claims to quote individual opinions, as it is so easy for those interested, to deny the accuracy of reporters, and throw upon the latter all the errors which a close review may bring to light; but the article under the above heading in the *N. Y. Tribune* of the 23d inst., so far as the individual opinions quoted is concerned, bears upon its face, so much that is consistent with their well known views, that I am constrained to notice, as briefly as possible, the article referred to, which is so replete with misstatements of fact, and the attendant false inference deviseable therefrom, as to be very misleading, unless some one cognizant of the facts referred to, should take the trouble to rectify the errors of the *Tribune*.

Taking the paragraphs in their order, I might properly ask, who are the engineers to whom reference is made, as having expressed opinions adverse to the construction of this dam? And echo answers—"Who are they?" I might extend the query still further, and ask who is the modest individual who sets up his private judgment upon a technical question, adverse to that of all the professional gentlemen who, *entitled* to an opinion on the subject have been enquired of? I answer; a lawyer, appointed by the Legislature as one of seven commissioners, who mistaking his purely administrative functions as a commissioner, arrogates to himself also the technical duties of an engineer; and doubtless with some glimmerings of the absurdity of his position in the premises, endeavors to evade the responsibility which he had assumed, by denying that the construction of the Quaker Dam involves in any sense any question of engineering! If such be the case, why, I would ask, was a half score or so of engineers, prominent for their experience in hydraulic engineering, selected to examine and report upon it?

It is next stated that the plans for dam submitted by Commissioner H. O. THOMPSON, were so severely handled, that the commissioner fully impressed with their insufficiency, had withdrawn them, and others *stronger* had been substituted. This is not the fact. The form of dam has in no way been determined officially, and the plan as submitted by H. O. THOMPSON has not been withdrawn and is still before the commission.

It is true that Mr. BARNES, prior to his appointment as commissioner, had submitted a plan of curved dam, which he had an unquestioned right to do, but he has no right to use his present position as a commissioner, to further the adoption of that plan; and if his curved dam is the only safe plan, he might with great propriety leave the determination of this to the decision of engineers of far greater experience than he, in such works, and who can have no personsal motive to bias their judgment in the selection of a proper plan, and who would be well disposed to do ample justice to the design of an American engineer, in competition with that of foreign engineers, did their judgment permit of any question as to their relative merits. And further, Mr. BARNES is in error in citing authorities in favor of his curved dam. It is true, that some of the later high dams are curved on plan, but the curve in all cases was a slight segment of a circle, applied to narrow ravines, and never a full semi-circle, or anything approaching it; and the writers he cites, and others, Spanish, French, and English, are most emphatic in condemning a trust to the action of an arch, and recommend most decidedly that the estimate of the resistance of the dam, shall be made upon the basis that its plan is a straight one!

If Mr. BARNES thinks, as is stated, that the plans as submitted by the Department of Public Works for this dam, based upon foreign examples, would, in its results, "be a doubtful experiment" what shall we say of his design for this dam, which is semi-circular in plan, and introduces elements of stress and strains, unthought of in any existing dam on the face of the earth! Tens of thousands of masonry dams exist, many of them for centuries, whose stability depends solely upon the inertia of their mass; the strains resulting therefrom being well understood and provided for: The Quaker-dam as prepared by the Department of Public Works differing substantially only in its increased dimensions; while a semi-circular arch of over a thousand feet span laid on its face, and designed to resist without leakage, the pressure of water ranging in depth from zero to over 200 ft. differs so radically from anything hitherto attempted in the way of arches or dams as to be properly characterized in no other way than as a stupendous experiment *which will never be tried*.

It is an error to state that Chief Engineer BIRDSALL is in favor of this form of dam.

The inference allowed in Commissioner SPENCER's answer, that there are *forty* miles of new bridges and highways required, of which he has not seen the specifications, is characteristic, and calls for no comment.

The seventy mill powers which he allows to be inferred will be destroyed by this proposed dam, and for the value of which, no estimates have been furnished, must be valuable indeed, if, lying as it were in the city of New York, they have remained unimproved to this late day! Commissioner SPENCER is next quoted as saying that he believes the dam will cost "two or three times the estimate of the engineers." Computed at the latter rate, this would make the cost as over *sixteen millions* of dollars. Elsewhere he says, that the engineers estimate of the cost of this dam as submitted to Commissioners, "is little better than guess work." We might well ask if his own estimate is any other than the wildest guess?

Commissioner SPENCER is reported as saying, that Mr. FRANCIS and the other experts to whom the question of this dam was referred, had no plans or specifications of the structures submitted to them upon which to pass judgment. This statement is equally erroneous with others from the same source. These gentlemen were put in possession of the plans and all needed information in reference to the dam, prior to their reporting thereon. They did not need a *plan* of dam when reporting upon the value of reservoir *storage*, but when reporting upon the dam as an engineering work, they needed the plans, and they had them.

The next guess of Mr. SPENCER is as to the insalubrity of the water after storage in the big reservoir. It might be sufficient to quote Dr. CHANDLER'S report upon this very matter, wherein he most emphatically declares that not the slightest apprehension need exist in the public mind upon this point. Mr. SPENCER not only usurps the functions of the engineer, but as well, that of an expert sanitarian, and denies the accuracy of the conclusions reached by probably the first sanitarian in our midst, who is supported by the concurrent testimony of the Medical Society of the County of New York.

Mr. SPENCER here says that the conclusions to which he arrives, are "self evident," and need no endorsement of scientests, etc. The judge should be milder in condemning "the eleven obstinate jurymen." His practice as a lawyer should have taught him the *possibility* at least, of the truth lying with the large majority, rather than with the single man, though the latter be called *a* judge, not *the* judge.

Commissioner SPENCER then makes a false issue, when he alludes to the absurdity of building this dam to save the drainage of 23 additional square miles of water shed, when he knows, or ought to know, that this dam at the Quaker bridge, instead of saving 23 square miles merely, is the only means whereby the water of 115 square miles of the Croton water shed can be stored; and further, Mr. FRANCIS did *not* say that the infiltration caused by this high dam would exceed the amount which could be garnered from the additional area, but that the additional area of 23 square miles of shed was desirable, as the infiltration *might*, under adverse conditions, *equal* the drainage from that area. The statements are not be confounded. The 40 miles of country road of which we read previously, comes in here, as per the engineer's estimate as but *twenty-four* miles of new road to replace such as will be submerged; and the bug-bear of a "bridge for Westchester county, which will be required, one mile in length, and with piers in 100 ft. depth of water, to replace the existing wooden structure of Quaker bridge," according to the statement attributed to Commissioner SPENCER is not an alarming feature, when we bear in mind that provision is

made in the big dam itself being rendered a bridge, at about the same level above the surface of the reservoir, as now obtains by the old wooden bridge above the Croton river in the immediate vicinity of the dam.

The reporters then quote the opinions of Mr. O. B. POTTER. Mr. POTTER is a highly respectable gentleman, who has amassed a large property by the exercise of his native shrewdness, and is the owner of the land upon or near which it is proposed to place this dam; and in the public hearings before the Aqueduct Commission, had made himself a conspicuous opponent of its construction, as well as the system of storage of which it forms a part, and whatever else it may be rumored Mr. SPENCER owes to Mr. POTTER, one thing is clear, and that is, that some of the most brilliant figures of speech which crop out at intervals in Mr. SPENCER'S minority report, were evidently inspired by Mr. POTTER'S oratory—the phraseology being more than accidentally coincident with passages in the speeches of the latter. It is true that the text of both, using the changes on the same theme,—"the danger to the public health and the public purse"—popular themes with the small politicians, and so very naturally bearing a family likeness to one another, but an intelligent observer could not fail to have perceived at these public hearings, even from the first, that there was something more than accidental in the coincidences referred to. There is an unwritten page in the history of the Aqueduct Commission, which it is to be hoped will one day see the light, but for the present it will suffice to observe, that when Mr. POTTER, in his speeches, referred to the *public* interests, it is safe to replace the word *public*, by O. B. POTTER; and where Mr. SPENCER refers to that same public, he has in view the pronounced sentiments of Mr. O. B. POTTER; and the opposition itself, might properly be narrowed down to embrace the POTTER-SPENCER interests.

This digression is called for, that it may be fairly understood, that the closing paragraph as reported, does not represent, as would appear on its face, an independent public sentiment, voiced by O. B. POTTER, but is the POTTER-SPENCER opposition tactics, enunciated in the bolder manner, becoming the leader of a forlorn hope.

It will be remembered that the Aqueduct Commission by a late vote of six to one, have, after three years of delay (for what purpose does not appear, but we may hope the time was improved, in seeking light on a subject of which they could know but little) decided, that the construction of this dam was a necessity to the future of this city. The single adverse vote of Mr. SPENCER, was followed by the publication by him of a minority report (printed but not issued, a year since) and in accord with the well-known opinions of Messrs SPENCER and POTTER, as expressed at the earlier meetings of the Commission, and understood as being entertained by Mr. SPENCER when he first took his seat in the Commission. I do not say that this opinion was the price of his seat, but I say that his opposition was known to exist long before he could have formed an intelligent opinion of the merits of the case, having had no opportunity for acquiring such opinion, either in his previous legal practice, or in the infancy of the Aqueduct Commission's experience.

Returning to the stated opinion of Mr. POTTER; he says, he "looks upon this project as one of great peril to the city, not by the loss of a few thousands(?) lives by the destruction of the dam which will be sure to give way as other dams have! but as a menace to the health of the city," and then proceedes to enlarge upon the amount of filth of various kinds which he says will, "fill the bottom and render the whole body of water unfit to drink," and which, "cannot be drawn off." In answer to all this, we have the highest possible medical, chemical, and sanitary authority already referred to, for regarding the enormous volume of 38377 *millions* of gallons in the reservoir, as safe from dangerous pollution, if for no other reason than its bulk alone; but whatever impurity may collect near the bottom of the reservoir, ample provision will be found in the plans of the engineer for flushing it during freshets, if need be, into the Hudson river.

In conclusion Mr. POTTER says. "There is no need to build this dam, and it is a great political and engineering job," which the public, when they appreciate it, "will not submit to." If Mr. POTTER sees a political job, it is very likely that there is one somewhere. That his eyesight is keen in that direction, is not to be doubted, and he probably knows a good deal about it, whether it be to manufacture a President, Governor, or to bring some smaller fry to the surface of the political chaldron "*Quien Sabe?*" Engineering jobbery, however, is quite another thing, of which he knows less, and in which his eyesight is scarcely so well trained, but jobbery as we understand the term, in any direction in connection with matters of such vital importance, as the water supply of this great city, should be exposed, and we call upon Mr. POTTER, as an honest man, and avowed custodian of the public interests, *to do it* without fear or favor, or ever after hold his peace.

W.

Fast Tunneling again Compared.

NEW YORK, March 3, 1887.

EDITOR ENGINEERING NEWS:

In your last issue exception is taken by Mr. W. L. S. to the "exceptionally rapid tunnel driving at Shaft 15 of the new Croton Aqueduct" and he figures out that better work was done at Shaft 23 last summer, because more cub. yds. were removed in the lump; but your correspondent neglects to add the most important item to his bill, *i. e.*: the number of drills employed in both places; therefore he does not tell your readers how much work was done with each drill, on an average. This you know is what decides the merits of the machines used. We can make it out very clearly by a parallel column exhibit:

Shaft 23.	*Shaft* 15.
Section of tunnel driven 12½ x 12½.	Section of heading driven 8 x 16.
In this instance the tunnel was not driven to grade, some bench being left in all the way through.	
No. of cub. yds. per foot (12½ x 12½) 5.5.	No. of cub. yds. per foot (8 x 16) "ACTUALLY TAKEN OUT."
	Say 3.75 only.
Greatest progress south 265½ ft. in twenty-six days, with six Ingersoll Eclipse Drills. (4 on heading and 2 in bench.)	Greatest progress south 316 ft. in twenty-five days, with 3 Rand Slugger Drills.
No. of cub. yds. taken out 1,460.25.	No. of cub. yds. taken out 1185.
No. of cub. yds. taken out per day 56.	No. of cub. yds. taken out per day 47.4.
No. of cub. yds. taken out per day per Ingersoll Eclipse Drill 9.3.	No. of cub. yds. taken out per day per Rand Slugger Drill. 15.8.
Greatest progress north 254½ ft. in twenty-two days with six Ingersoll Eclipse Drills.	Greatest progress north 268 ft. in 24⅔ days with two Rand Slugger Drills.
No. of cub. yds. taken out, 1,399.75	No. of cub. yds. taken out 1080.
No. of cub. yds. taken out per day, 63.	No. of cub. yds. taken out per day 44.
No. of cubic yards rock taken out per day per Ingersoll Eclipse Drill, 10½.	No. of cubic yards rock taken out per day per Rand Slugger Drill 22.
Greatest progress in one week, 83 ft., which equal 456.5 cub. yds., with six Ingersoll drills in six days.	Greatest progress in one week 90 ft. which equals 337.5 cub. yds. with three Rand Drills in six days.
No of cub. yds per day per Ingersoll Eclipse Drill 12.6.	No. of cub. yds. per day per Rand Slugger Drl. 18.6.

I have taken the bench and heading together at Shaft 23 against the heading alone at Shaft 15 for the sake of argument only; you well know that the bench and heading are worked separately and distinctly one from the other, and that no comparison should be made of both against one: yet even that way the result is far different from what your correspondent assumed.

Yours truly,
V. M. B.

The Detroit River Winter Bridge.

Chief Engineer's Office, Michigan Central R. R. Co.
DETROIT, Mich., Feb. 25, 1887.

EDITOR ENGINEERING NEWS:

I enclose blue print of proposed winter bridge at Detroit over Detroit river, which you will understand is only a general plan and may be changed somewhat in details. The removable span will probably be a single track span for the present, with piers long enough for a second single track span. The piers are shown as going to rock, but this will probably be an unnecessary expense. It is a rare sight to see a sailing vessel going up or down the Detroit river, except in tow of a tug or steam barge. With the openings shown, this bridge would be practically no obstruction to navigation. The bottom of the river is soft enough so allow the current to rapidly restore the normal cross-section of the river after piers are put in.

The Detroit people are quite decided in their views on this bridge question, and appreciate the necessity of building a winter bridge. In summer time the passage of the river on our large car ferries is an agreeable change for passengers, but in winter time we have occasionally some delays caused by ice in the river. This with the expense of the car ferries in winter, make a bridge almost a necessity.

Yours truly,
J. D. HAWKS.
Chief Engineer.

Bridge Guard Rails.

DUNMORE, Pa., Feb. 24, 1887.

EDITOR ENGINEERING NEWS:

In your paper of February 19, you say that it is bad practice to set guard rails on bridges away from main rail. Where Latimer's rerailing device is used, the close guard rail is necessary, but where no such device is used I have gained the impression that the guard rail should be away from main rail, and for the following reason: A de-railed truck dragged on to a bridge with close guard rail stands an even chance of forcing the guard rail or main rail out of place so as to spoil track for following wheels; or of climbing the guard rail and dropping on to ties again inside where the guard rail would be of no use. On the other hand, should the guard rail be away from main rail, a de-railed truck has a chance to run over the bridge with the wheels confined between the rails.

Yours truly,
A. D. B.

[Timber guard-rails are undoubtedly, in the best practice, set at enough distance from the rail to admit of the passage of a derailed wheel, but the usual practice with inside guard *rails* of metal and of the same form as the main rails, is to place them nearly as close to the main rail as the lower flange permits, running them to a point in much the same fashion as with the Latimer re-railing safety-guard. At least, this is a large country to say of it that anything is "usual," but the information available to this journal is that it is almost universal. The idea is that rails thus placed will be very likely to bring about re-railing even without re-railing frogs. A timber guard-rail is not rigid enough to make any such effort hopeful.

The Massachusetts Railroad Commission, in December, 1881, issued a circular on bridge floors in which several different types were shown, including the flaring guard-rails with Latimer safety-guard, which the Commission especially recommended, in a cheaper form which is not covered by patent; the re-railing frogs being of wood with a ¼ in. iron plate covering. We find we were in error in supposing the Latimer patent to have run out, but the royalty asked is not great, and those unwilling to pay a small price for the best article can use the cheaper one without price, ED. ENG. NEWS.]

SOCIETY PROCEEDINGS.

CANADIAN INSTITUTE OF CIVIL ENGINEERS.—The inaugural meeting of this new Society was held in Montreal last week. The following officers were elected: President, T. C. KEEFER; 1st. Vice-Prest., WALTER SHANLEY; 2nd. Vice-Prest., Col. C. S. GZOWSKI; 3rd. Vice-Prest., J KENNEDY; Secretary-Treasurer Prof. H. T. BOVEY. The Council is made up of ALLAN MCDOUGALL, H. D. LUMSDEN, H. F. PERLEY, F. W. GRITHORNE, W. L. POOLE, P. W. ST. GEORGE, E. P. HANNAFORD, H. WALLIS, S. KEEFER, ANDREW PETER, H. B. RUTTAN, W. T. JENNINGS, L. LESAGE, P. A. PETERSON and Prof. H. T. BOVEY. Montreal was decided upon as the place of meeting. In the evening a conversazione was held and Sir WM. DAWSON welcomed the young society and hoped to see it at some day attain the usefulness and importance of the great civil engineering institutes of Great Britain and the United States.

Le Génie Civil, in speaking of the artesian wells in South Algeria says that L'Oued Rir, an oasis in this section, is like a little Egypt with a subterranean Nile. Since 1856, the year of conquest, 117 flowing artesian wells have been put down and lined with iron tubing; and to these must be added over 500 wells sunk by the natives and lined with wood. The total flow from these wells is about 1,000 U. S. galls. per second, equivalent to one-tenth of the volume of the Seine at low water. This artesian well water comes from a point about 250 ft. below the surface and has a mean temperature of about 77° Fahr. In those thirty years the value of the land in this oasis has been quintupled, thanks to the French artesian wells. Other fertile spots are being now created in this desert by similar methods.

CONSTRUCTION NEWS.

Water.

Ramapo Water.—Mr. K. H. Lamport has been explaining to Mayor Whitney of Brooklyn, how that city can obtain 30,000,000 galls. of water daily from the Ramapo river in New Jersey.

New England Water-Works Association.—A meeting will be held on Wednesday, March 9, at 12 o'clock, noon, at Young's Hotel, Boston, Mass. Mr. ALBERT F. NOYES, City Engineer of Newton, Mass., will read a paper entitled "The Driven Well System as a Source of Water Supply."

Emporia, Kan.—Proposals were opened on Monday for the construction of the dam for the city water-works. The plans were prepared by ROBERT MILLIKEN, City Engineer, and the cost is estimated at $162,000. The contract for the water-works extension of engine house and dam, was let in January to the Holly Manufacturing C'., Lockport, N. Y., at $142,000. The bonds voted for the entire work are $162,000. Work will be commenced as soon as the weather will permit.

Montclair, N. J.—The Town Committee has decided to accept the proposition of the Bartlett syndicate to build a reservoir and lay pipes. The contract will be for a term of years, with the privilege of allowing the town authorities to purchase the works and pipes at any time at the cost thereof. The scheme is to furnish the supply from large storage reservoirs in the northern part of the State along the watershed of the Passaic valley, Lake Macopin, etc., with the intention of supplying many large cities, including Newark and Jersey City.

Schenectady, N. Y.—The Water Commissioners have made their report for the year 1886. The plant of the Schenectady Water Co. was purchased in 1885, and the report covers the first year of operation by the city. The entire cost of the water system to date is $99,080, to which will be added $15,575 for the new Gaskill high duty engine and two boilers, now under contract; this engine, manufactured by the Holly Manufacturing Co., will have a capacity of 3,000,000 gallons. The Dean pumps now in operation have worked satisfactorily. The works were built in 1871 and the water is pumped direct from the Mohawk river. The population is about 13,365. The total consumption was 405,008,270 gallons. During the year 10,434.5 feet of new mains have been laid, making a total of 15.1 miles; 11 hydrants have been set, 149 now in use; 14 gates have been set and 189 service connections. M. O. CALDWELL, is Superintendent, and CADY STALEY, Consulting Engineer.

Tonawanda, N. Y.—The town has voted to accept a proposition from the water company by which the town will pay $4,580 annually for 100 hydrants for 20 years, and $40 for every additional hydrant. North Tonawanda has made an agreement to pay the company $3,500 annually for 72 hydrants for 20 years, and $40 for every additional hydrant. The works, which are now in operation, comprise nine miles of mains, and five and a half miles will be laid this season. There are two Gaskill engines built by the Holly Manufacturing Co., of Lockport, N. Y., and having an aggregate daily capacity of 4,000,000 gallons. The Tonawanda City Water Works Co. has filed a mortgage with the American Loan and Trust Co., of New York, for $120,000. With this money the company will extend the works and increase their capacity.

Helena, Mont.—Referring to the article on the water-works case in our issue of last week (p. 146) Mr. GEORGE F. WOOLSTON, of Boston, Mass., writes us that he received a charter from the City Council giving him the franchise for a period of 20 years and agreeing to pay a stated rental for 150 hydrants and to take ten hydrants per mile of additional pipe laid. An injunction was granted on the petition of the old water company, which furnishes water through open ditches and wooden troughs, giving no fire pressure. Mr. WOOLSTON states that he did not drop out of the case, but came east to consult with other lawyers, who advised him that his charter and contract were valid. In the Supreme Court of Montana the decision of the court below was sustained by two judges, a third dissenting, holding that the injunction should be dissolved; the case will now go to the court below again on its merits, and will be carried to the U. S. Supreme Court. The council has granted Mr. WOOLSTON another charter, which states that no rights under the first charter shall be interfered with, and he has contracts with three-quarters of the consumers by which they agree to take water from him for ten years. Material is being purchased and work will be commenced as soon as the frost is out of the ground.

Sandusky, O.—The Council at its last meeting passed an ordinance to submit to the citizens at the April election, the question of issuing bonds to the amount of $67,000 for the purchase of a new pumping engine (of at least $5,000,000 gallons daily capacity) and for the extension of water mains. The city now has in the sinking fund a surplus of $15,000, so that, should the vote be favorable, the water-works board will have at its disposal for the purpose named, $82,000. The State has selected a tract of 90 acres, one mile south of the city, as a site for the proposed Soldiers' and Sailors' Home. A sewer to drain the grounds is nearly completed, and an 8-in. water main will be extended to them at once. The city is to supply the Home with water at $25 per annum for 13 years. Plans have been prepared for buildings, which will be upon the cottage plan, and for the improvement of the grounds, and the trustees expect to advertise the work very soon. Two avenues leading from the city to the grounds are to be improved at once by the city and county, at an estimated cost of $35,000; Mr. CHAS A. JUDSON is City Engineer.

Plymouth Mass.—The Water Commissioners have made their report for 1886. The works are owned by the town and were constructed in 1855. The source is from Great and Little South ponds and Lout pond, and the water is supplied part of the way by gravity and then pumping. The engines are of Worthington manufacture and the total amount pumped was 214,477,051 gallons, 435 gallons per pound of coal. The estimated population to date is 7,400; 6,200 on line of pipe, and 6,100 supplied; average daily consumption 589,822 gallons. The distribution mains are of wrought-iron, cement lined, from 2-in. to 20-in. diameter; 10,486 ft. were laid and 23.5 miles are now in use; one hydrant was added and there are now 67 public and 8 private in use; 17 stop gates were added, making a total of 182. The service pipes are of lead and cement lined; from .5-in. to 1-in. diameter; length of pipe, 5 miles; service taps, 1,284; motors and elevators, 2. A report on increased supply by WALTER H. SEARS, C. E., of Boston, is printed. Superintendent, RICHARD. W. BAGNELL.

Springfield, Mass.—The Board of Water Commissioners has submitted its report for 1886, being the thirteenth annual report. During the year 15,825 ft. of high service, and 3,168 ft. of low service pipe have been laid, from 1-in. to 12-in. diameter; total length, 78.65 miles. Of gates, 60 have been set and 18 taken out; number in use, 696. Of fire-hydrants, 47 have been set and 11 taken out; number in use, 560: on the high service 322 belong to the city and 57 are private, on the low service 168 belong to the city and 13 are private. Of cement lined pipe 4,767 ft. have been replaced by iron, and this work must be continued; there are now 35 miles of this pipe in use. Some repairs have been made and it is stated that to maintain the pressure on the high service the present waste must be stopped or another main laid to Ludlow.

The works are owned by the city, and have been constructed in 1864, 1874 and 1886; the supply is by gravity and is obtained from impounding reservoirs at Ludlow and Belchertown. The estimated population is 39,000, of which 33,750 are on the line of pipe, and 29,000 are supplied. The total consumption for the year was 1,368,750,000 gallons of which 5¾ per cent. passed through meters; the average daily consumption was 3,750,000. The distribution mains are of wrought-iron, cement lined wrought-iron and cast-iron, from 1.5-in. to 30-in. diameter; the range of pressure is, high service, 90 to 120 pounds; low service, 30 to 35 pounds. The service pipes are from .5-in. to 4-in. diameter; there are now in use, 4,519 taps, 349 meters and 98 motors and elevators. J. C. HANCOCK is Superintendent.

Railroads Bridges and Canals.

The Fort Worth Car & Foundry Co. has been organized at Fort Worth, Tex. Capital stock, $500,000.

The Fort Smith Bridge Co. has been incorporated at Little Rock, Ark., to build a bridge across the Arkansas river at that city. President, Col. WM. H. H. CLAYTON. Capital stock, $400,000.

Wagon Road.—A good wagon road is to be built from the Montezuma valley, Col., to the Atlantic & Pacific R. R. It will be an advantage to Cortez and Taltie. According to the survey it will be 107 miles long, over level country.

Mining in Maine.—*The Industrial Journal*, of Bangor, Me., reports that CAPT. VAGUE has been working the Hercules mine in Penobscot this winter, and has shipped 15 tons of lead and silver ore to the smelting works of Professor BARTLETT at Portland. The prospects are said to be encouraging.

The Meigs Elevated R. R.—CAPT. MEIGS states that if the city council of Cambridge, Mass., grants the location he has petitioned for, he will commence the construction of the first mile of road about the middle of this month.

Arthur Kill Bridge.—At Washington, Senator Frye, from the committee on commerce, has reported adversely the bill introduced by Senator McPherson to amend the act authorizing a bridge to be constructed across the Arthur Kill. The report says it does not seem proper to compel the railroad companies to construct the bridge upon a plan different from that which Congress has defined in the original act or upon one not approved by them and not considered even when the bill was passed.

The Alachua Canal & Drainage Co. has been incorporated at Orlando, Fla., by MARK A. HARDIN and others.

Railroad Projects in Maine.—It is reported that there are now 20 definite railroad projects in the State, of which 15 have organized companies. In addition to the Canadian Pacific R. R. and Quebec Central R. R. interests there are three projects for lines in Aroostook county. The Northern Maine R. R. is proposed to run from Presque Isle to Mattawamkeag.

New Bridges Authorized.—The U. S. Senate has passed bills authorizing the construction of the following bridges. By the Chicago, St. Paul, Minneapolis & Omaha R. R. Co., across the Missouri at Sioux City; a bridge over the Mississippi at Grand Tower, Ill., fixing the main span at 650 ft., and the other spans at 500 ft.; bridges across the Great Kanawha river below the falls; bridges across the Red river of the North, and a bridge over the East river at Blackwell's Island, New York City.

An Inter-State Railroad.—A "dummy" railroad is projected between Leavenworth, Kan., and Kansas City, Mo., land is being purchased and the road will be built this summer. It will probably be an extension of the Inter-State R. R. which is now being built to a point six miles northwest of Wyandotte, Kan., from which point to Fairmount, a suburb of Leavenworth, is eight miles. From Fort Leavenworth, three miles east of Leavenworth, to the end of the present road at Wyandotte is about 28 miles.

Rapid Transit.—The Omaha Cable Co., of Omaha Neb., has been organized by FRED GROSS of Kansas City, Mo.; a franchise will be applied for in April.—The Cable Tramway Co., of Omaha, Neb., president, S. R. JOHNSON, is building its line.—The Chicago West Division Railroad Co. is experimenting with a new form of cable railroad, in which the conduit is very small, and the cable has buttons which engage with a sprocket wheel on the car; when the conductor brakes this wheel the car is moved along and when he releases it the cable merely causes it to revolve.—The Metropolitan Street Railroad Co., of Atlanta, Ga., contemplates putting in two 60 H. P. engines, two 50 H. P. dynamos and 10 H. P. motors on the cars; the Van Depoele system is proposed; president, J. W. RANKIN.—The Pine Street Railroad Co., of Jacksonville, Fla., proposes to adopt an electric system; manager, HENRY S. ELY.—At Bangor, Me., an electric street railroad is proposed; the Sprague system has been suggested; F. H. CLERGUE is interested.—The Brighton Hill & Chelsea Park Railroad Co. has been incorporated to build a steam railroad from the Interstate Rapid Transit R. R. in Kansas Kan., southwest to the county line, 15 miles; D. M. EDGERTON, W. P. BARRETT and others; capital stock, $200,000.—The Central Rapid Transit Co. has been incorporated at Baltimore, Md., by EDWARD LARKIN, GEORGE L. MCCAHAN, and others; capital stock $100,000. The company proposes to divert the water of Jones' falls into Gwynn's falls by a tunnel and to lay its tracks in the bed of Jones falls; the plans are to be submitted for approval to a committee composed of N. H. HUTTON, engineer of the harbor board; ROBERT K. MARTIN, engineer of the water board, and CHARLES H. LATROBE, engineer of the Jones' falls commission.

Bridges.—The Duluth, South Shore & Atlantic R. R Co. will build a bridge across the Sault Ste. Marie and another across the St. Lawrence at Brockville, Ont.—A bridge is to be built across the Mississippi river to connect Marshall avenue, St. Paul, and Lake street, Minneapolis; cost, $150,000, of which Hennepin and Ramsey counties will pay $75,000 each.—The Illinois Central R. R. bridge at East Cairo, Ill., is being built by the company and not by contract; work is in progress on the 3,000-ft. trestle, which will be completed by April.—The New York, New Haven & Hartford R. R. Co. will erect a bridge across the Connecticut river at Lyne, Conn.—The Maine Central R. R. Co. will erect an iron bridge across Lake Maranacook to replace the present wooden structure.—The Atchison, Topeka & Santa Fé R. R. Co. is preparing for work on the bridges at Sibley, Mo., and Fort Madison, Ia., as soon as the plans have been approved by the Secretary of War.—The Rome Land & Improvement Co. will build an iron bridge at Rome, Ga.—At St. Paul, Minn., a bridge is to be built across the Mississippi at Forbes street.—At Wilmington, Del., a new bridge will be built over the Brandywine river, with space for a street railroad.—At Rochester, N. Y., an appropriation for $35,000 has been recommended for a new bridge across the Genesee river, and the swing bridge over the Erie canal is to be replaced with a lift bridge.—The old arch bridge over the Patapsco river, near Ilchester, Md., has been condemned by J. W. BOLLMAN, C. E., of Baltimore, and W. H. SHIPLEY, bridge inspector for Baltimore county; a new bridge will be built.—At Albany, N. Y., a bridge is proposed across Canal street; cost not to exceed $100,000.—A bridge is to be built over the Mississippi river, near Dubuque, Ia.—At Alpena, Mich. three of the seven piers of the railroad bridge across Thunder Bay river have been completed.

Street Railroads.—Biddeford & Saco Horse Railroad Co., Biddeford, Me.; STEPHEN F. SHAW, president; CHARLES H. PRESCOTT, Secretary; capital stock, $50,000.——Weatherford Street Railroad Co., Weatherford Tex.; J. M. BORRIL and others; capital stock, $50,000.——Huntington Street Railroad Co., Huntington, L. I.; three miles; CASPER D. SCHUBERTH, of Brooklyn; capital stock, $30,000.——Decatur & North Park Street Railroad Co., Decatur, Ill.; MICHAEL ELSON and others; capital stock, $25,000.——El Dorado City Railroad Co., El Dorado, Kan.; capital stock, $60,000——City & suburban Street Railroad Co., Kankakee, Ill.; DANIEL H. PADDOCK; capital stock, $10,000.——Greenville Street Railroad Co., Greenville, Miss.,; JOHN GUNN, General Manager; construction commenced.——Newton City Street Railroad Co., Newton Kan.; ALLEN MOORE and others; capital stock, $60,000.——Colfax Avenue Railroad Co., Denver, Col.; H. B. CHAMBERLIN, Secretary; capital stock, $25,000.——Greensburg Street Railroad Co., Greensburg, Kan.; G. W. MELVILLE; capital stock, $100,000.——At Tampa, Fla., a street railroad company has been incorporated by J. B. WALL, GEO. A. BOAZ and others.——At Norristown, Pa., a street railroad company has been organized; GEO. R. KITE, secretary.——At Eufaula, Ala., a street railroad company has been organized by ELI SHORTER, S. H. DENT and others.——At Taunton, Mass., the Scadding Street Railroad Co., has been granted right of way.——The Lowell & Dracut Street Railroad Co., Lowell, Mass., has purchased cars and rails for operations this spring.——The Richmond City Railroad Co., Richmond, Va., will extend the road.——At Augusta, Ga., a suburban line will be built by BOYKIN WRIGHT and turned over to the Augusta & Summerville Street Railroad Co.——At Calais, Me., a street railroad is projected; E.F. DECAMP, of New York, is interested.

Railroad Companies.—Roodhouse & Quincy R. R. Co.; between the cities named in Illinois, with a branch to Hannibal, Mo.; S. C. WAGONER, J. C. ESSICK and others; office at Pana, Ill.; capital stock, $800,000.——Memphis, Trinidad & Pueblo R. R. Co.; President, GEORGE SIOME, Denver, Col.; capital stock, $18,000,000.——Jeffersonville & New Albany R. R. Co.; between the cities named in Indiana; J. C. FAUCETT, GEORGE PFAU and others; capital stock, $100,000.——Jefferson City & Southwestern R. R. Co., 140 miles; GEO. C. SMITH, of St. Louis, Mo., and others; capital stock, $2,800,000; this scheme is backed by JAY GOULD.——Mississippi River R. R. Co., 185 miles, from Jefferson county, Mo., to Dunklin county; GEO. C. SMITH, E. C. MERRIAM, of St. Louis, and others; capital stock, $3,700,000; this scheme is also in the JAY GOULD interest.——Hastings, St. Paul & Cannon Falls R. R. Co.; M. V. SEYMOUR, Hastings, Minn.; capital stock, $1,000,000.——Northern Pacific & Atlantic R. R. Co., from Brockville, Ont., to connect with the Hoosac Tunnel line; AUSTIN CORLIN and others; the Duluth, South Shore & Atlantic R. R. will be acquired.——Kanas City, Linn & Southern R. R. Co.; 500 miles, office at Mound City, Kan.; ROBERT KINCAID and others; capital stock, $5,000,000.——Houston Central, Arkansas & Northern R. R. Co.; from Pine Bluff, Ark., to Houston, Tex., 430 miles; JAMES CONVERSE, San Antonio, Tex., and others; this is reported to be in the JAY GOULD interest.——Amoret & Southwestern R. R. Co., from Topeka, Kan., 500 miles; THOMAS A. OSBORN, Topeka, Kan.——Omaha & Southwestern R. R. Co., O. H. BENTLY, Wichita, Kan.; capital stock, $3,000,000.——Merchants' Bridge R. R. Co., of St. Louis; five miles, to connect with the new bridge; F. C. BETTS, St. Louis, Mo.; capital stock, $50,000.——Durham & Northern R. R. Co.; J. S. CARR, Durham, N.C.——Cincinnati, Huntsville & Birmingham R. R. Co., at Montgomery, Ala.; WM. RICHARDSON, B. P. HUNT.——Palatka, Welaka & Spring Grove R. R. Co.; from Cisco, Fla., to Georgetown and Citra; J. C. GREELEY, H. T. BAYER and others.

Proposals Open.

Montana Central R. R.—(*Special telegram* March 4). Proposals for the construction of this railroad, advertised on page XII last week, will be opened at Helena, Mont., on the 25th inst. J. T. DODGE, Chief Engineer.

Railroad Grading.—Between Minot, Dak., and the Great Falls of the Missouri, in Montana; 500 miles; nearly all the work is adapted to wheel and drag scrapers; work will commence April 1 to 15. Shepard, Winston & Co., St. Paul, Minn.

Pumping Engines.—Horizontal, compound, condensing engines of 8,000,000, 10,000,000 or 12,000,000 gallons daily capacity; with boilers, etc. THE BOARD OF TRUSTEES, Lake View, Ill. March 7.

Cast Iron Pipe.—Water pipe and castings, 910 tons, THE BOARD OF TRUSTEES, Lake View, Ill. March 7.

Piles.—For Oconto harbor, 10,000 lin. ft. Capt. CHAS. E. L. B. DAVIS, U. S. Engineer Office, Milwaukee, Wis. March 7.

Bridge.—Superstructure of Twentieth street bridge. ANDREW RINKER, City Engineer, Minneapolis, Minn. March 7.

Dredging.—Docks on the Schuylkill and Delaware rivers. GEO. A. COTTON, President, Board of Port Wardens, Philadelphia, Pa. March 7.

Paving and Sewer Pipe.—Cement or granolithic pavement in market house, 300 ft. of 9-in. vitrified pipe sewer with 6-in. connections. JAMES BROWN, Comptroller, Allegheny, Pa. March 7.

Water Works Supplies.—Pipe and branches, fire plugs and stop cocks, ferrules, castings, lead, fuel, etc. JAMES BROWN. (as above). March 7.

Sewers and Cedar Block Paving.—WM. CARLYLE, Chairman, Committee on Works, Toronto, Canada. March 8.

Curbing.—Granite curbing and flagging. WILLIAM DIXEY, Commissioner of City Property, City Hall, Philadelphia, Pa. March 9.

Sewer.—DEPARTMENT OF CITY WORKS, Municipal Building, Brooklyn, N. Y. March 10.

Well.—Drilling two or more wells for about 3,000 ft.; bids to be so much per ft. for the first 1,000 ft. and so much per ft. for each 500 ft. thereafter; the contractor to furnish everything. CADIZ OIL & NATURAL GAS CO., Cadiz, O. March 10.

Iron Work.—For post office at Keokuk, Ia., March 10; for post office at St. Joseph, Mo., March 11; for court house at Fort Wayne, Ind., March 16. M. E. BELL, Supervising Architect, Treasury Department, Washington, D. C.

City Work.—Medina stone improvement, sewer and plank walks. THOMAS J. NEVILLE, Clerk, Executive Board, Rochester, N. Y. March 11.

Artesian Well.—Between 2,600 and 3,300 ft. deep. F. H. MCDONALD, City Clerk, Greeley, Col. March 15.

Cells.—In the new city hall. ROBERT BRAND, Chairman, Building Committee, Oshkosh, Wis. March 15.

Ditch Work.—Reconstruction of the Wm. Busby joint ditch, in Cuyahoga and Lorain counties. Excavation mostly earthwork. WILLIAM H. BREW, county clerk, Cleveland, O. The work will be sold at auction by FRANK R. LANDER, Engineer, at the L. S. & M. S. R. R. bridge over the ditch near Olmsted Falls Village, at 10. a. m., March 15.

Breakwater.—At Agate bay, Minn.; 500 ft. of foundation of rip-rap and crib-work of timber filled with stone. CAPT. JAMES B. QUINN, U. S. Engineer Office. Duluth, Minn. March 21.

Granite Wharf.—At custom house, Charleston, S. C. M. E. BELL, Supervising Architect, Treasury Department, Washington, D. C. March 23.

Flatboats.—Five square decked flatboats, 90 ft., by 20 ft., by 3 ft.; for the Mississippi river improvement between the Des Moines rapids and the Illinois river. CAPT. E. H. RUFFNER, U. S. Engineer Office, Quincy, Ill. March 23.

Railroad.—Completion of branch from Killbuck to Dresden Junction, 33 miles. JAMES HARRISON, Akron, Chief Engineer. N. MONSARRAT, President, Cleveland Akron & Columbus R. R., Akron, O. March 25.

Sewerage System.—Plans with City Engineer. R.C. LIGHTBODY, Mayor, El Paso, Tex. April 4.

Contracting.

Brick.—The Vicksburg Water Supply Co. has awarded the contract for 400,000 brick to Messrs. Beck & Bro., at $9 per 1,000.

The Kansas Paving Co. has been incorporated at Topeka, Kan., by W. A. Sells, H. W. Roby and others. Capital stock, $25,000.

Sprinkling Carts.—At Denver, Col., the contract for 13 sprinkling carts for the city has been awarded to the W. J. Kinsey Implement Co. at $194.98 each.

Pier.—The Consolidation Coal Co. has awarded the contract for a coal shed 36 by 616 ft. at Locust Point, to Ross & Sanford, Jersey City, N. J.

The Pennsylvania & New England Construction Co. has been incorporated at Jersey City, N. J., by CHARLES MACDONALD, New York City; R. C. H. BROCK, Philadelphia, and others. Capital stock, $300,000. The company will undertake the construction of bridges piers, viaducts, etc.

The Summerville Creosoting Works are moving their plant to a location on the Cooper river at Charleston, S. C. New and improved machinery will be put in to bring the new works up to a first-class standard. A specialty is made of creosoted piling. F. W. CROCKER, Charleston, S. C., is agent.

Pier Work.—The following propsals were opened March 2 at the Department of Docks, New York City: For repairing pier at 152nd street; Thomas O'Connell and Michael J. Coffee, Brooklyn, $5,975; Fearon & Jenks, New York, $6,023; Wells & Van Riper, New York, $6,676; John Gillies, New York, $7,475; W. P. Kelly, New York, $7,500; James D. Leary, New York, $8,440. The contract was awarded to Thomas O'Connell and Michael J. Coffee.

For removing old work, building new pier and dredging at pier 32, East river: John Gillies, New York $2,310, $21,460, 40 cts. Thomas O'Connell and M. J. Coffee, Brooklyn, $1,500, $22,775, 60 cts. Warren Rosevett, New York, $2,255, $ 26,700, 55 cts. P. Sanford Ross Jersey City, $2,350, $27,700, 60 cts. Wm. P. Kelly, $2,800, $28,321, 60 cts. James D. Leary, New York, $2,340, $29,890, 60 cts. The contract was awarded to John Gillies.

Steel Forgings.—The following proposals have been received at the Ordnance Office, War Department, Washington, D. C., for 3.2-in. steel gun forgings: Cambria Iron Co., Johnstown, Pa., 65 cts. per lb. for all forgings; Midvale Steel Co., Philadelphia, Pa., 39 cts. per lb. for tubes and jackets, and 72 cts. per lb. for the remainder (average 47.2 cts. per lb.) The contract has been awarded to the Midvale Steel Co.

The United States Railroad Improvement Co., of East St. Louis, Ill., has been incorporated by John K. Hayward, Jay L. Torrey and F. W. Lovett, to do a general railroad construction business. Capital stock, $500,000.

Engines and Boilers.—The following proposals have been received by LIEUT. COL. WM. E. MERRILL, U. S. Engineer Office, Cincinnati, O., for engines and boilers for use at the Davis Island dam on the Ohio river: John G. Fritsch, Cincinnati, O., $2,546. Thomas Carlin's Sons, Allegheny, Pa., $2,876.

Levee.—County Surveyor FRANK KNIGHT, C. E. of Wabash, Ind., recently made a survey and estimate for a levee to protect the low-lands within the city limits. It would be one mile long, 12 ft. high and 18 ft. wide, and the cost, including 25 acres of land to be condemned, would be about $20,000. About 125 acres of land would be reclaimed.

Water Pipe.—At Rochester, N. Y., the contract for cast-iron water pipe and specials has been awarded to the Donaldson Iron Co., Emaus, Pa., at $12,400. The lowest bid was from the McNeal Pipe & Foundry Co., Burlington, N. J., but the pipe could not be furnished at the time required.

The Ingersoll Rock Drill Co., of New York City, reports the following sales: the Mary Murphy Mining Co., of Colorado, has placed an order for a complete rock drilling plant, including a 20 by 30-in. Ingersoll "straight line" air compressor, air receiver, two 60 H. P. return tubular boilers, seven Eclipse drills and a car load of wrought iron pipe for conveying the air from the compressing plant to the drills in the tunnel. The Lady Murphy mine, adjoining the Mary Murphy, near St. Elmo, Col., has placed an order for a 14 by 24-in. Ingersoll "straight line" compressor, 60 H. P. boiler, three drills, etc. The plant will be located at the switch and the air conveyed up the mountain through 2,500 ft. of 5-in. pipe

Cherry Creek Bridge.—The following proposals have been received at Denver, Col., for the construction of the iron bridge over Cherry creek: Superstructrue; Phœnix Bridge Co., (J. A. L. WADDELL, agent, Kansas City, Mo.) $5,649; Milwaukee Bridge & Iron Works, Milwaukee, Wis., specification *A* $7,795, specification *B* $10,465; Columbia Bridge Co., Dayton, O., $7,095.50; Kansas City Bridge & Iron Co., Kansas City, Mo., $8,100; Mount Vernon Bridge Co., Mount Vernon, O., $8,125; Missouri Valley Bridge & Iron Works, Leavenworth, Kan., $8,195; J. B. Diver & Co., Keokuk, Ia., $8,200; King Iron Bridge & Manufacturing Co., Cleveland, O., $8,400.——Substucture; McDermott & Beatty, Denver, stone masonry (Fort Collins) $18.99 per cu. yd., (lava stone with Fort Collins footings) $17.95; concrete, $7.90 per cu. yd. Harney Bros., Denver, stone, $23.65; concrete, $6.60, Giddes & Seerle, Denver, masonry, $24; concrete, $9.

Street Work.—The following proposals were opened Feb. 26, by the Board of Public Works, East Saginaw, Mich.: On Third St.: Sapless cedar block paving, 3,075 sq. yds., Scanlan & Crowley, 83 cts.; Talbot Paving Co., 79 cts.; Hurley Bros., 89 cts. Excavation, 1,800 cu. yds., (bids for earth to bslong to the contractor and to the city respectively), 15 and 28 cts., 30 and 20 cts., 18 and 18 cts. Medina stone curb, 1,925 lin. ft., 50 cts., 48 cts., 52 cts. Bond timber, 800 ft. B. M., $15, $13, $13, Culvert covers, six, $2, $2, $1.50. Relaying old paving, 30 sq. yds., 35 cts., 15 cts. Tile drain, 110 rods, $1.50, $2; $1.75. Totals (the earth to belong to the contractor and to the city respectively), $3,979.75 and $4,069.75; $4,137.75 and $3,957.75; $4,274.25 (both).

On Miller street; totals, Scanlan & Cowley, $1,670.40 and $1,703.35; Talbot Paving Co., $1,723.35 and $1,657.45; Hurley Bros., $1,787.27 (both alike). On Warren street; totals, Scanlan & Crowley, $1,330.80 and $1,366.60; Talbot Paving Co., $1,400.05 and $1,328.45; Hurley Bros., $1,430.38 (both alike). On Emerson street; totals, Scanlan & Crowley, $1,881.95 and $1,939.85; Talbot Paving Co., $2,012.95 and $1,897.15; Hurley Bros., $2,047.37 (both alike). The contracts for the four streets have been awarded to Scanlan & Crowley, of East Saginaw, the earth to be the property of the contractor. JOHN J. GRANVILLE is the City Engineer.

Water Works Plant.—At Oberlin, O., the following proposals have been received: *Pumping Machinery*: Knowles Steam Pump Works, New York, $5,850; Gor-

don & Maxwell, Hamilton, O., $6,379: Deane Steam Pump Co., $7,495; Geo. F. Blake Co., New York, $7,890: Holly Manufacturing Co., Lockport, N. Y., $8,050; H. Worthington, New York, $7,890.—*Cast-Iron Pipe*; Buffalo Cast Iron Pipe Co., Buffalo, N. Y., $32.50 per ton; Lake Shore Foundry, Cleveland, O., $33.45; Cincinnati & Newport Iron & Pipe Co., Newport, Ky., $40; Jackson & Woodin Manufacturing Co., Berwick, Pa., $40.75; Dennis Long & Co., Louisville, Ky, $40.75; Shickle, Harrison & Howard Iron Co., St. Louis, Mo., $42.—*Pipe laying*; Bids were received from the following parties, W. F. Otis, Norwalk, O.; P. Sullivan, Fremont, O.; Adam Miller & Co., Rome, N. Y.; C. H. Voute, Toledo, O.; W. H. Myers & Son, Hillsdale, Mich.; Oberlin Gas Light Co.; Homegardner & Conley, Sandusky, O.; H. N. P. Dole & Co., Columbus, O.; Michael McKean, Sandusky, O.; J. C. Ross & Co., Elyria, O.; J. E. Magrath, Liberty, Va.; R. B. Carothers, Newport, Ky; J. C. Harlow, Pittsburg, Pa.; Snyder & Williams, Dayton, O.; J. J. Rumsey, Canton, O.; W. M. Chisholm, East Liverpool, O.; W. H. Crooks, Massillon, O. The highest and lowest bids were, for 4-in., 14¢ to 25 cts. per ft.; for 6-in., 18 to 31 cts.; for 8-in., 19¾ to 39 cts., and for 12-in., 30 to 44 cts.—*Hydrants*; Coffin Valve Co., Boston, Mass., $26. Galvin Brass & Iron Works, Detroit, Mich., $26.50. United States Pump & Valve Co., Boston, Mass., $26.60. Wm. Bingham & Co., Cleveland, O., $26.83. James Flower & Bros., Detroit, Mich., $27. Eddy Valve Co., Waterford, N. Y., $28. Bourbon Copper & Brass Works, Cincinnati, O., $29. Holly Manufacturing Co., Lockport, N. Y., $30. Ludlow Valve Co., Troy, N. Y., $30.82. Chapman Valve Co., Indian Orchard, Mass., $30.85. R. D. Wood & Co., Philadelphia, Pa., $31.50. *Gates*; The lowest bid was from Rouse & Hills Co., Cleveland, O., $470.34.

The work will include 6.75 miles of mains, 70 hydrants, and pumping machinery with a daily capacity of $1,250,000 gallons. The supply is taken from the Vermillion river at Kipton, four miles from the pump well, to which the water flows by gravity through a line of 12-in. sewer pipe. The trenching is in rather heavy clay and the mains are to be laid with the center five feet below the surface. We are indebted for this information to CHARLES A. JUDSON, City Engineer and Superintendent of the water-works at Sandusky, O.

Railroad Contracts.—Joseph Ross has been awarded the contract for the extension of the Essex branch of the Boston & Maine R. R.

J. F. B. Jackson, of Blount Springs, Ala., has been awarded the contract for grading the Mineral R. R. extension from Redding to Boyles' Gap, Ala.

Mr. Norton, of Waterville, Me., has been awarded the contract for constructing four miles of the York Harbor & Beach R. R. There will be half a mile of trestle.

Mr. McLain, of Kissimmee, Fla., has been awarded the contract for grading the Orange Belt R. R. from Macon to Point Pinellas.

Victor A. Yecker, of Lancaster, Pa., and R. G. Jenkins, of Philadelphia, have been awarded the contract for tracklaying on the Kansas City, Wyandotte & Northwestern R. R., 150 miles west from Kansas City, Mo. These parties last year graded 40 miles and laid the track on 130 miles of the Kansas, Nebraska & Dakota R. R.

R. B. Largdon & Co., of St. Paul, Minn., have been awarded the contract for the Merrill extension of the Chicago, Milwaukee & St. Paul R. R. from Merrill to Tomahawk, 53 miles. The work will be in sand and gravel, with no tunnels, but a bridge across the Wisconsin river; it is to be finished this season and will be started shortly.

The Fitzgerald & Mallory Construction Co. has been awarded the contract for the construction of the Denver, Memphis & Atlantic R. R., a portion of the Missouri Pacific system; the headquarters have been removed from Wichita to Winfield, Kan.

Harrison & Green, of Milwaukee, Wis., have been awarded the contract for the construction of 60 miles of the Duluth, South Shore & Atlantic R. R., from near Hurley, Wis., to the east branch of the Ontonagon river.

McMurtrie & Woodward, of Sault Ste. Marie, Mich., have been awarded a contract on the Duluth, South Shore & Atlantic R. R., and have 15 miles to sublet.

The contract for the construction of the extension of the Minneapolis, Sault Ste. Marie & Atlantic R. R. from Hermannsville to Saunders Point, Mich., will be let shortly.

The Duluth, South Shore & Atlantic R. R. is now all under contract and the location is so far advanced that contractors can commence work on each division

The Pennsylvania Construction Co. will build the Pensacola & Memphis R. R.

John Kelley, of Philadelphia, Pa., has been awarded the contract for grading the Shellport branch of the Philadelphia, Wilmington & Baltimore R. R.; the line will be four miles long, from the main line at Edge Moor through South Wilmington to the line at Delaware junction, there will be three bridges. Work is to be commenced at once and the line is to be in operation by August. Contracts will soon be let for the bridge work.

Foundations and Chimney.—The following proposals were opened Feb. 25, by the Water Board, Boston Mass., for work at the Chestnut hill pumping station:

Items.		T. C. Davis, Allston.	Collins & Ham, Boston.	Moulton & O'Mahoney, Lawrence.	William H. Ward, Lowell.	R. R. Meyers, & Co., Boston.	D. Connery & Co., Boston.	Patrick Grace, Brighton.
	cu. yds.	Per cu. yd.	Per cu. yd.	Per cu. yd.	Per cu. yd.	Per cu. yd.	Per cu. yd.	Per cu. yd.
Earth excavation	2,400	0 54	0.65	0.27	0.50	0.62	1.25	1.25
Rock excavation	10	2.00	5.00	1.50	2.00	5.00	10.00	3.00
Am. cement concrete	600	4.50	3.75	3.92	4.00	4.50	4.00	5.00
Portland cement concrete	30	6.50	4.75	6.00	6.00	6.00	5.00	7.50
Brick masonry	560	9.75	13.50	13.25	13.00	14.45	13.75	15.00
Brick masonry in chimney	480	9.25	13.50	13.00	14.25	15.55	14.50	25.00
Rubble stone masonry	2,700	4.00	4.50	5.65	6.00	6.25	6.75	6.25
Dimension stone masonry	50	50.00	25.00	42.00	50.00	40.00	60.00	80.00
	Total	$26,826	$30,632.50	$33,415	$35,840	$37,982	$40,710	$46,636

The contract has not yet been awarde[illegible].

Post Office.—The contract for the extension of the Post office at Bangor, Me., has been awarded to Foster & Son, of Waterville, Me., at between $12,000 and $13,000; the appropriation is $15,000.

The Jersey City Tunnel.—The proposed tunnel at the Washington St. Gap, in Jersey City, N. J., will be 2,150 ft. long, and 23 ft. wide at the north approach and will descend at 6 ft. per 100 ft., it will pass under the canal in a double tunnel 260 ft. long, and 720 ft. will be in single tunnel. The total estimated cost is $285,000. Proposals for its construction will be received by the Board of Public Works until March 14.

Dam.—The following proposals have been received by Capt. E. H. RUFFNER, U. S. Engineer Office, Quincy, Ill.: Patterson Bros., Keokuk, Ia.: rock, $1.49 per cu. yd.; brush, 74 cts. per cu. yd.: total, $40,170. A. J. Whitney, Le Claire, Ia.; rock, $1.60; brush, 75 cts.; total, $42,600. Jacob Richtman, Fountain City, Wis.: rock, $1.71; brush, 81 cts.; total, $45,630. The contract has been awarded to Patterson Bros.

Fog Signal House.—The following proposals for the erection of a fog signal house, keeper's dwelling, etc., at the Gull Rocks light station, Narragansett bay, R. I., have been received by Lieut. JOHN MILLIS, U. S. Light House Engineer (Third District), Tompkinsville, N. Y.: L. Seely, $2,886; Henry A. Tolbert, $3,157; Jos. C. Terrey, $3,220; Francis H. Smith, $4,990.

Asphalt Paving.—The proposal of the Warren-Scharf Asphalt Paving Co., for paving at St. Paul, Minn., (see p. 147) was the only one for asphalt paving; it was made up as follows: Holly avenue, 9,535 sq. yds., $31,270; Portland avenue, 9,898 sq. yds., $31,125; Dayton avenue, 25,505 sq. yds., $79,400. L. W. RUNDLETT, City Engineer, informs us that the method of letting contracts in St. Paul is by the lump sum; these prices, therefore, include the asphalt paving, granite curbing, excavation and some other small details of the work. The pavement is guaranteed to be left in perfect condition at the end of ten years. The bids are considered satisfactory.

Paving, Stone and Lumber.—The following contracts have been awarded by the Works Committee, Toronto, Canada: *Paving*: Ardagh & Leonard; pavement, 77 cts. per sq. yd.; curbing, 19 cts. per ft.; crossing plates, $2.5¢ per 100 pounds. E. & C. Farquhar; pavement, 76 and 78 cts.; curbing, 20 icts.; crossing plates, $2.75. Wm. Cathro; pavement, 80, 87, and $1.10; curbing, 19, 20 and 87 cts.; crossing plates, $2.95 and $3; stone setts, $1.55. A. W. Godson, pavement, 85 cts.; curbing, 23 cts., crossing plates, $3. *Stone*: W. T. Stewart $7.50 and $8.50 per toise; J. Hilts, $7.90 and $8.90; W. W. Goldring, $7 and $9. *Lumber*: J. J. Hall, $11.70 per 1,000 ft. B. M., for gang sawn pine lumber, and $13 for cedar scantling.

Pipes, Hydrants, Etc.—At Richmond, Va., contracts for supplies for the City Water-Works have been awarded as follows: Pipe: 4-in., $40 per ton of 2,240 pounds; 6 and 8-in., $38; 10, 12, and 16-in., $37; Tredegar Pipe Co., Richmond. Special castings, $2.24 per cwt.; Tanner & Delaney Engine Co., Richmond. Fire-hydrants (Ludlow), single nozzle, $20.60; double nozzle, $24.35; lead, $4.97 per cwt.; Geo. A. Smith, Richmond. Stop valves (Eddy), 4-in., $8.10; 6-in., $13.95; 8-in., $20.25; 10-in., $27; 12-in., $36; 16-inch., $67.50; solder, $13.40; Southern Railway Supply Co., Richmond.

Pipe.—The following proposals for water pipe have been received by the water-works, Cleveland, O.: Lake Shore Foundry, Cleveland, O., 3-in. to 12 in. and 30-in. pipe, $29.50 per ton; specials for same sizes, 3 cts. per pound. Cincinnati & Newport Iron & Pipe Co., Newport, Ky., 3-in. to 12-in. pipe, $33; 30-in. pipe, $32.40; all specials, 3.5 cts. R. D. Wood & Co., Philadelphia, Pa., 30-in. pipe and specials, $32.40 and 3.5 cts. New Philadelphia Pipe Co., New Philadelphia, O., 30-in. pipe and specials, $33 and 3.5 cts. The contract has been awarded to the Lake Shore Foundry.

Water Pipe.—The following proposals were opened Feb. 28 for supplying the water-works, Boston, Mass., with 40 tons of 48 in. pipe, 35 tons of 36-in., and 40 tons of special castings: R. D. Wood & Co., Philadelphia, Pa., $33.75 per ton of 2,240 pounds; specials, $68.40; McNeal Pipe & Foundry Co., Burlington, N. J., $34.75, $86.80. Gloucester Iron Works, Philadelphia, Pa., $34.91, $82.91. Builders' Iron Foundry, Providence, R. I., specials, $70. The contract was awarded to R. D. Wood & Co.

Bridge.—The following proposals for the superstructure of the steel arch bridge at Minneapolis, Minn., have been received by ANDREW RINKER, City Engineer: Smith Bridge Co., Toledo, O., $53,000; Morse Bridge Co., Youngstown, O., $59,023; Wrought-Iron Bridge Co., Canton, O., $64,000; Shiffler Bridge Works, Pittsburg, Pa., $73,800; King Iron Bridge & Manufacturing Co., Cleveland, O., $75,000; Minneapolis Bridge Co., Minneapolis, Minn., $76,500; W. G. Coolidge & Co., Chicago, Ill., $78,220; Keystone Bridge Co., Pittsburg, Pa., $79,900; Horace E. Horton, Rochester, Minn., $79,900, Keepers & Reddell, Milwaukee, Wis., $84,374.80; A. Gottlieb & Co., Chicago, Ill., $108,364.80.

Water Pipe, Hydrants, Etc.—The following proposals have been received for materials for the water-works at Geneseo, N. Y.: *Pipe and Castings*; Sayre Pipe Foundry, Sayre, Pa., 4, 6, 8 and 10-in. cast iron pipe, $32.75, $32.75, $31.85, $31.85; castings, 3 cts. Warren Manufacturing Co., Phillipsburg, Pa., pipe, $34,82; castings, 2¾ cts. Donaldson Iron Co., Emaus, Pa., $35.50, $34, $34, $33; 2¾ cts. McNeal Pipe Co., Burlington, N. J., $35.75, $34.36, $34, $34; 3 cts. John Fox, New York City, $37.05, $36.56, $33, $33; 2.9 cts. Jackson & Woodin Manufacturing Co., Berwick, Pa., $37.50, $36, $36, no bid; 3½ cts. The contract was awarded to the Sayre Pipe Foundry.

Pumping Engine, Boiler and Iron Chimney; Holly Manufacturing Co., Lockport, N. Y., $4,200. George F. Blake Manufacturing Co., New York City, $4,380. Knowles Steam Pump Works, New York City, $4,500. Edgerton Brenner (Dean or Blake pumps), $4,658. Henry R. Worthington, New York City, $5,200. Gordon & Maxwell, Hamilton, O., $5,600. The contract was awarded to the Holly Manufacturing Co.

Hydrants; Chapman Valve Co., Indian Orchard, Mass., $23.08. John McLean, New York City, $24. Edgerton Brenner (Holyoke), $24 Galvin Brass & Iron Co., Detroit, Mich., $24. John Fox, New York City. (Coffin), $240. Holyoke Hydrant Works, Holyoke, Mass., $24.50, Ludlow Valve Co., Troy, N. Y., $24.80. Eddy Valve Co, Waterford, N. Y., $25. Whittier Machine Co., Boston, Mass., $25.80. James Flower & Bros., Detroit, Mich., $27. Holly Manufacturing Co., Lockport, N. Y., (Gaskill,) $28, Union Hydrant Works, Philadelphia, Pa., $28.75. R. D. Wood & Co., Philadelphia, Pa., (Mathews), $30.50, Walter S. Payne & Co., Fostoria, O., $35. The contract was awarded to the Ludlow Valve Co.

Stop Valves; (4,6 8 and 10-in. double hub, 10 in. double flanged, 8-in. hub and flanged); Rensselaer Manufacturing Co., Lansingburg, N.Y., $7.78, $12.40, $18.37, $26.30, $27.15, $18.95, James Flower & Bros., Detroit, Mich., $7.96, $12.38, $18.60, $26.50, $27.50, $19.60. John Fox, New York City, $8[illegible] $13, $19, $28.35, $28.35, $19. Walter S. Payne & Co., Fostoria, O., $8.10, $13.75, $19.75, $26, $26, $19.75. Holyoke Hydrant Works, Holyoke, Mass., $8.75, $13.25, $19.75, $26.75, $26.75, $19.75. Eddy Valve Co., Waterford, N. Y., $8.10, $13.95, $20.25, $27, $37, $20.25. Galvin Brass & Iron Co., Detroit, Mich., $8.70, $13.35, $20.40, $30.05, $30.05, $21.25. Union Hydrant Works, Philadelphia, Pa., $8.90, $12.25, $20.50 $28.60, $33.75, $31.50, Ludlow Valve Co., Troy, N. Y., $8.85 $14.25, $21.36, $29.50, $30.50, $30.50, $21.80. Chapman Valve Co., Indian Orchard, Mass., $8.85, $13.59, $20.17, $30.72 $33.84, $20.95. Holly Manufacturing Co., Lockport, N. Y. $8.75, $13.70, $22, $32, $32, $22. Whittier Machine Co., Boston, Mass., $9.50, $15, $22, $29.25, $30.25, $29.75. R. D. Wood & Co., Philadelphia, Pa., $9.90, $15.50, $22.50, $31.50, $31.50, $22.50. Lehigh Valley Brass Works, $9.63, $15.40, $23.10, $11.90, $33, $24.60. John McLean, New York City, $10.75, $17, $25, $32, $33, $26. The contract was awarded to the Rensselaer Manufacturing Co. JOHN YOUNG is the engineer in charge, and J. NELSON TUBBS, consulting engineer.